EPA/ROD/R08-00/512
2000

EPA Superfund
Record of Decision:

CALIFORNIA GULCH
EPA ID: COD980717938
OU 07
LEADVILLE, CO
06/06/2000

RECORD OF DECISION

APACHE TAILING IMPOUNDMENTS
OPERABLE UNIT 7
CALIFORNIA GULCH SUPERFUND SITE
LEADVILLE, COLORADO

June 2000

U.S. Environmental Protection Agency
999 18th Street, Suite 500
Denver, Colorado 80202

RECORD OF DECISION

APACHE TAILING IMPOUNDMENTS OPERABLE UNIT 7
CALIFORNIA GULCH SUPERFUND SITE
LEADVILLE, COLORADO

The U.S. Environmental Protection Agency (EPA), with the concurrence of the Colorado Department of Public Health and Environment (CDPHE), presents this Record of Decision (ROD) for the Apache Tailing Impoundments Operable Unit (OU) 7 of the California Gulch Superfund Site in Leadville, Colorado. The ROD is based on the Administrative Record for Apache Tailing Impoundments OU7, including the Remedial Investigation/Feasibility Study (RI/FS), the Proposed Plan, the public comments received, including those from the potentially responsible parties (PRP), and EPA responses. The ROD presents a brief summary of the RI/FS, actual and potential risks to human health and the environment, and the Selected Remedy. EPA followed the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, the National Contingency Plan (NCP), and EPA guidance (EPA, 1999) in preparation of the ROD. The three purposes of the ROD are to:

1. Certify that the remedy selection process was carried out in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9601 *et seq*., as amended by the Superfund Amendments and Reauthorization Act (collectively, CERCLA), and, to the extent practicable, the NCP;

2. Outline the engineering components and remediation requirements of the Selected Remedy; and

3. Provide the public with a consolidated source of information about the history, characteristics, and risk posed by the conditions of Apache Tailing Impoundments OU7, as well as a summary of the cleanup alternatives considered, their evaluation, the rationale behind the Selected Remedy, and the agencies' consideration of, and responses to, the comments received.

The ROD is organized into three distinct sections:

1. The **Declaration** section functions as an abstract and data certification sheet for the key information contained in the ROD and is the section of the ROD signed by the EPA Regional Administrator.

2. The **Decision Summary** section provides an overview of the OU7 characteristics, the alternatives evaluated, and the analysis of those options. The Decision Summary also identifies the Selected Remedy and explains how the remedy fulfills statutory and regulatory requirements; and

3. The **Responsiveness Summary** section addresses public comments received on the Proposed Plan, the RI/FS, and other information in the Administrative Record.

DECLARATION

DECLARATION

SITE NAME AND LOCATION

Apache Tailing Impoundments Operable Unit 7
California Gulch Superfund Site
Leadville, Colorado
CERCLIS # COD980717938

STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for Apache Tailing Impoundments (OU7) within the California Gulch Superfund Site in Leadville, Colorado. EPA, with the concurrence of CDPHE, selected the remedy in accordance with CERCLA, as amended by Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the NCP.

This decision is based on the Administrative Record for Apache Tailing Impoundments (OU7) within the California Gulch Superfund Site. The Administrative Record (on microfilm) and copies of key documents are available for review at the Lake County Public Library, located at 1115 Harrison Avenue in Leadville, Colorado, and at the Colorado Mountain College Library, in Leadville, Colorado. The complete Administrative Record may also be reviewed at the EPA Superfund Record Center, located at 999 18th Street, 5th Floor, North Terrace in Denver, Colorado.

The State of Colorado, as represented by CDPHE, concurs with the Selected Remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances at and from Apache Tailing Impoundments (OU7), if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Apache Tailing Impoundments (OU7) is one of 11 OUs identified as source areas, and includes four tailing impoundments referred to as the Main Impoundment, North Impoundment, Tailing Pond No. 2 and Tailing Pond No. 3. The overall site management plan involves source remediation. Pursuant to the August 26, 1994 Consent Decree at this Site, it was agreed that the decision on remediation of surface water and groundwater site-wide (i.e., OU12) would be made only after records of decision for source remediation were selected and implemented at each OU. Remedial actions undertaken within the Apache Tailing Impoundments (OU7) site are consistent with the site work area management plan.

The first response action taken at Apache Tailing Impoundments (OU7) was completed in August 1997 as a Time Critical Removal Action to remove source area material from Tailing Ponds Nos. 2 and 3 and consolidate the material with the Main Impoundment. This removal action involved excavating of approximately 41,500 cubic yards of tailing, underlying soil and berm material. The excavated material was placed on top of the Main Impoundment. Clean soils from the Hecla Borrow Pit (OU2) were used to backfill, regrade, and cover the excavated area. In addition, the southwest slope of the Main Impoundment along the California Gulch drainage was regraded and stabilized to provide erosion protection. In 1999, ASARCO Incorporated (Asarco) installed wick drains in the Main Impoundment to facilitate dewatering of the subsurface slimes. They also backfilled the North Impoundment to promote surface water drainage. These removal actions are consistent with the Selected Remedy, which is described below.

The Selected Remedy for addressing the Apache Tailing Impoundments (OU7) will be the second response action and consists of a soil cover with a geosynthetic barrier as presented as Alternative 3A in the *Final Focused Feasibility Study, Apache Tailings Impoundments - Operable Unit 7 (OU7)* (McCully, Frick & Gilman, Inc. [MFG], 2000). The Focused Feasibility Study (FFS) evaluated and screened remedial alternatives retained in the site-wide Screening Feasibility Study (EPA, 1993) for impounded tailing within OU7. The FFS used a comparative analysis to evaluate nine alternatives and identify the advantages and disadvantages of each. The Selected Remedy for the tailing impoundments includes the following features:

- Surface water controls will include the channelization of California Gulch through the southern portion of the Main Impoundment and diversion ditches to provide surface water run-on and run-off control. The channelization of California Gulch will involve the excavation and relocation of tailing from the southern portion of the Main Impoundment, removal of the clay-tile culverts, and plugging of the wooden box culvert. Tailing excavated from these activities will be placed on top of the Main Impoundment and in an area between the Main and North Impoundment to create a single combined tailing area, which will be covered with a continuous barrier system encompassing both impoundments.

- Application of source surface controls to the impounded tailing will consist of regrading the impoundments, placement of a multi-layer composite cover over the combined tailing area, and revegetating the covered surface. The impounded tailing will be graded in a manner to reduce the potential for erosion, improve the stability of embankment slopes, eliminate ponding, and achieve positive drainage. The multi-layer cover system will consist of 18-inches of clean borrow soil, placed over a geotextile drainage net and a geosynthetic barrier. The seed mixture will include native and introduced grass and forb species for self-sustaining plant community that will not require irrigation or nutrient supplements.

- Institutional controls will be established to warn potential hazards and to maintain the effectiveness of the remedy by limiting access to or use of property (current and future use scenarios) including temporary and permanent measures. Modifications to County and/or city zoning ordinances will involve the creation of

a zoning "overlay district" to provide a screening process to identify properties where special precautions or requirements may be needed.

- A long-term monitoring program will be established to assess the quality of surface water and groundwater following implementation of the remedy.

The Selected Remedy is protective of human health and the environment through the following:

1. The cover will eliminate airborne transport of tailing particles;

2. Positive drainage grading will eliminate ponding of water on the tailing surface, reducing the potential for infiltration into the impoundment;

3. The geosynthetic barrier and vegetated soil cover will greatly reduce infiltration of precipitation and limit potential for erosion of tailing material;

4. Slop stability will be increased by regrading and flattening existing side slopes.

5. Lowering the phreatic surface within tailing impoundment will minimize groundwater contact.

STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. Given the type of waste present at this site, this remedy uses permanent solutions (e.g., engineered covers) to the maximum extent practicable. Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above health-based levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial action to ensure that the remedy is protective of human health and the environment. This remedy is acceptable to both the State of Colorado and the community of Leadville.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record for this site.

- Contaminants of concern and their respective concentrations.
- Baseline risk represented by the contaminants of concern.
- Cleanup levels established for chemicals of concern and the basis for these levels.
- How source materials constituting principal threats are addressed.
- Current and reasonably anticipated future land use assumptions used in the baseline risk assessments and ROD.
- Potential land use that will be available at the site as a result of the Selected Remedy.

- Estimated capital costs, annual operation and maintenance costs, and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.
- Key factors that led to selecting the remedy.

Max H. Dodson
Assistant Regional Administrator
Ecosystems Protection and Remediation
U.S. Environmental Protection Agency, Region VIII

6/6/00
Date

DECISION SUMMARY

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LIST OF ACRONYMS AND ABBREVIATIONS

ABA	Acid-base accounts
AGP	Acid generating potential
AMSL	Above mean sea level
ANP	Acid neutralization potential
AOC	Administrative Order on Consent
APEN	Air Pollution Emission Notice
ARAR	Applicable or Relevant and Appropriate Requirements
Asarco	ASARCO Incorporated
BARA	Baseline Aquatic Ecological Risk Assessment
bgs	Below ground surface
CD	Consent Decree
CDL	Colorado Department of Law
CDPHE	Colorado Department of Public Health and Environment
CDWR-SEO	Colorado Division of Water Resources, State Engineers Office
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cm	Centimeter
cm/sec	Centimeter per second
COC	Contaminants of Concern
Con	Consolidation
CWA	Clean Water Act
DS	Direct Shear
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ESI	Engineering-Science, Inc.
FEC	Foothills Engineering Consultants, Inc.
FFS	Focused Feasibility Study
FS	Feasibility Study
FT	Feet
Golder	Golder and Associates, Inc.
HI	Hazard Index
HQ	Hazard Quotient
Jacobs	Jacobs Engineering Group, Inc.
LL	Liquid limit
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MFG	McCully, Frick & Gilman, Inc.
NAAQS	National Ambient Air Quality Standard
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHPA	National Historic Preservation Act
NP	Non plastic

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

NPL	National Priorities List
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
OU	Operable Unit
P	Proctor
pcf	Pound per cubic foot
Perm	Permeability
PL	Plastic limit
PI	Plasticity index
PRP	Potentially Responsible Party
psf	Pounds per square foot
psi	Pounds per square inch
RA	Risk Assessment
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SAP	Sampling Analysis Plan
SFS	Screening Feasibility Study
SHPO	State Historical Preservation Officer
SIP	State Implementation Plan
SPLP	Synthetic Precipitation Leach Procedure
State	State of Colorado
TBV	Toxicity Benchmark Values
TX	Triaxial test
UAO	Unilateral Administrative Order
UCL	Upper confidence limit of the arithmetic mean
USCS	Unified Soil Conservation System
USDC	U.S. District Court
WAMP	Work Area Management Plan
Weston	Roy F. Weston, Inc.
WTP	Water Treatment Plant
WWC	Woodward Clyde Consultants
WWL	Water, Waste, and Land, Inc.
EF	degrees Fahrenheit
lbs/day	Pounds per day

1.0 SITE NAME, LOCATION, AND DESCRIPTION

Apache Tailing Impoundments Operable Unit 7
California Gulch Superfund Site
Leadville, Colorado
CERCLIS # COD980717938

The California Gulch Superfund Site is located in Lake County, Colorado, in the upper Arkansas River basin, approximately 100 miles southwest of Denver. The study area at the Site encompasses approximately 16.5 square miles and includes the towns of Leadville and Stringtown, a portion of the Leadville Historic Mining District, and the portion of the Arkansas River from its confluence with California Gulch downstream to the Lake Fork Creek confluence (see Figure 1). Elevations range from approximately 12,300 feet above mean sea level (AMSL) near the summit of Ball Mountain to approximately 9,430 feet AMSL at the confluence of Lake Fork Creek with the Arkansas River.

The California Gulch Superfund Site has been organized into 12 Operable Units (OU). Figure 2 shows the Site study area boundaries and the location of OU7 within the California Gulch Superfund Site. The U.S. Environmental Protection Agency (EPA) is the lead agency for the site and Colorado Department of Public Health and Environment (CDPHE) is the support agency. ASARCO Incorporated (Asarco), a potential responsible party (PRP), is financing the remedial actions.

The Apache Tailing Impoundments (OU7), consists of four distinct tailing impoundments, which include the Main Impoundment (occasionally referred to as Tailing Pond No. 1 in some previous reports), Tailing Pond No. 2, Tailing Pond No. 3, and the North Impoundment. The location of these impoundments are shown in Figure 3. The Apache Tailing Impoundments are located on the southern edge of Leadville adjacent to U.S. Highway 24. The tailing impoundments are located in California Gulch, approximately 1,500 feet downstream of the Yak Tunnel Water Treatment Plant (WTP) Surge Pond. In the vicinity of the Apache Tailing Impoundments, the floor of California Gulch is approximately 600 feet wide and slopes approximately four percent to the west.

The Main Impoundment (11.3 acres) is the furthest to the east and extends across California Gulch to the south. Tailing Ponds Nos. 2 and 3, which were removed in 1997, were located west and downstream of the Main Impoundment, and were approximately 1.5 and 0.5 acres in size, respectively. The North Impoundment (1.8 acres) is separated from the Main Impoundment by an old railroad grade. The analysis of tailing and underlying foundation soil samples collected from the impoundments indicated elevated concentrations of metals, primarily arsenic, cadmium, copper, lead, and zinc.

The California Gulch channel is the main surface water feature in the Apache Tailing Impoundments area. This channel conveys discharge primarily from the Yak Tunnel WTP and also, during high-flow periods, runoff from the upstream California Gulch watershed (OU4). Downstream of the Main Impoundment, the California Gulch channel also conveys flow that

originates from springs and the Parkville Water District storage tank discharge located in the area upstream of the Main Impoundment. These flows coalesce immediately upgradient of the Main Impoundment and are conveyed under the Main Impoundment through a culvert prior to discharge into California Gulch. Starr Ditch, located along the northern and western boundaries of the Apache Tailing Impoundments area, adds flow during periods of stormwater and snowmelt runoff to the channel downgradient of the site, near County Road 6.

The constructed portion of the California Gulch channel follows the south side of the valley upstream of the Main Impoundment, with most of this reach elevated above the valley floor. Historically, the natural California Gulch surface water channel in this area was located north of its present location. Currently, the California Gulch channel intersects the southern edge of the Main Impoundment where flow is routed through two 24-inch diameter clay-tile culverts. These culverts are bedded in alluvial materials beneath the Main Impoundment tailing, as evidence by borehole logs and the culvert inlet and outlet elevations. A wooden box culvert is present at the toe of the east embankment of the Main Impoundment and conveys surface water from the area upstream (east) of the impoundment below the elevated portion of the California Gulch channel.

Several foundations associated with former mill buildings are located at the northwest comer of the Main Impoundment and approximately 100 feet south of U.S. Highway 24. This mill, known as the Apache Mill, reprocessed tailing from the Main Impoundment and deposited the materials into Tailing Ponds Nos. 2 and 3. The operation of this mill may have begun as early as the late 1970s and continued into the 1980s.

2.0 OPERABLE UNIT HISTORY AND ENFORCEMENT ACTIVITIES

The California Gulch Superfund Site is located in the highly mineralized Colorado Mineral Belt of the Rocky Mountains. Mining, mineral processing, and smelting activities have produced gold, silver, lead, and zinc for more than 130 years in the Leadville area. Mining and its related industries continue to be a source of income for both Leadville and Lake County. The Leadville Historic Mining District includes an extensive network of underground mine workings in a mineralized area of approximately 8 square miles located around Breece Hill. Mining in the District began in 1860, when placer gold was discovered in California Gulch. As the placer deposits were exhausted, underground workings became the principle method for removing gold, silver, lead, and zinc ore. As these mines were developed, waste rock was excavated along with the ore and placed near the mine entrances. Ore was crushed and separated into metallic concentrates at mills, with mill tailing generally slurried into tailing impoundments.

Based on anecdotal information, the mill that generated the tailing placed in the Main Impoundment, and possibly the North Impoundment, was located on the hillside northeast of the North Impoundment. Based on information provided in the Historical Mineral Processing Operations report (Jacobs Engineering Group, Inc. [Jacobs], 1991), it is believed that this mill was known as the Venir Mill, the California Gulch Mill, and the Asarco Leadville Milling unit. Available historical information for these mills (Jacobs, 1991) suggest an operation period of 1939 to 1956.

The California Gulch Site was placed on the National Priorities List (NPL) in 1983, under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. The Site was placed on the NPL because of concerns about the impact of mine drainage on surface waters in the California Gulch and the impact of heavy metals loading in the Arkansas River (EPA, 1997).

Several subsequent investigations have been conducted within the California Gulch Superfund Site that have addressed the Apache Tailing Impoundments (OU7). A number of investigations were conducted prior to the remedial investigations (RI) for the purpose of evaluating physical characteristics and potential contamination. These investigations included studies by EPA (EPA, 1987 and 1989), Colorado Department of Law (CDL) (CDL, 1986), and Water, Waste and Land, Inc. (WWL) (WWL, 1990).

In September 1990, EPA and the PRPs entered into an Administrative Order on Consent (AOC) for the performance of soil sampling and air monitoring. EPA issued a Unilateral Administrative Order (UAO) in August 1991 that required Asarco to conduct studies and complete RIs.

The cultural resources of OU7 were surveyed by Foothills Engineering Consultants (FEC) in August 1995. FEC surveyed an area withing 100 feet surrounding the Apache Tailing Impoundments. The area surveyed is discussed in greater detail in *Cultural Resources Investigations of the Apache Tailings Area* (Asarco, 1995).

The tailing remedial investigation (Woodward Clyde Consultants [WCC], 1994) performed in the fall of 1991 was a comprehensive investigation encompassing five major tailing

impoundments and seven fluvial tailing deposits at the California Gulch Superfund Site. The study included descriptions of the Main Impoundment and Tailing Ponds Nos. 2 and 3, and an evaluation of surface water and groundwater impacts. The study included drilling and sampling 13 test borings and the completion of eight monitoring wells in and near the Apache Tailing Impoundments. Stability analysis results indicated that the steep tailing slope along the southwestern perimeter of the Main Impoundment was marginally stable. In addition, the study concluded that the Apache Tailing Impoundments and underlying foundation soils had elevated concentrations of metals, primarily arsenic, cadmium, copper, lead, and zinc. Groundwater in the Apache Tailing Impoundments area appeared to contain elevated concentrations of water quality parameters (and lower pH) relative to groundwater from upgradient wells. However, it was suggested that the elevated and variable concentrations of parameters in monitoring wells downgradient of the Apache Tailing Impoundments were possibly related to spatial variation or effects from California Gulch and Starr Ditch waters.

A surface water remedial investigation (Surface Water RI) of the California Gulch Superfund Site was conducted in 1991 and 1992. The final Surface Water RI report describing the results of the surface water investigation was issued in 1996 (Golder and Associates, Inc. [Golder], 1996a). The study included surface water and sediment sampling in the Arkansas River and its tributaries, including California Gulch. Sample locations in the vicinity of the Apache Tailing Impoundments included California Gulch upgradient and downgradient of the impoundment and Starr Ditch.

A groundwater remedial investigation (Hydrogeologic RI) at the California Gulch Superfund Site was conducted from the fall of 1991 through the winter of 1992. The study included installation of monitoring wells and piezometers, water level measurements, and groundwater sampling and analysis. The final Hydrogeologic RI Report describing the results of the investigation was issued in 1996 (Golder, 1996b). Objectives of the study were to investigate groundwater quality and flow directions, evaluate potential impacts to surface water receptors, and to characterize background groundwater quality. In the vicinity of Apache Tailing Impoundments, nine groundwater monitoring wells, four mini-piezometers, and three springs/seeps were monitored and sampled.

In 1993, the EPA conducted a Screening Feasibility Study (SFS) (EPA, 1993) to initiate the overall CERCLA feasibility study (FS) process at the California Gulch Superfund Site. The purpose of the SFS was to develop general response actions and identify an appropriate range of alternatives applicable to the various contaminant sources to be considered during feasibility studies for the California Gulch Superfund Site.

Asarco entered into a Consent Decree (CD) (U.S. District Court [USDC], 1994) with the United States, the State of Colorado (State), and other PRPs at the California Gulch Superfund Site on August 26, 1994. In the CD, Asarco agreed to perform certain remediation work in three operable units (OU5, OU7, and OU9). The Work Area Management Plan (WAMP), included as Appendix B to the CD (USDC, 1994), defines the scope of work to be performed by Asarco.

Remedial alternatives retained in the SFS for impounded tailing in OU7 were further evaluated and screened in a *Draft Apache Tailings Feasibility Study* (Draft FS), issued in January 1996

(Golder, 1996c). Pursuant to EPA and Colorado Department of Public Health and Environment (CDPHE) comments on the Draft FS, a Supplemental RI was performed to address some data gaps and changes in hydrologic conditions. The stated purpose of the Supplemental RI was to improve the current understanding of the interaction of waste materials, surface water, and groundwater in the Apache Tailing Impoundments area, specifically to chemical mass loading to California Gulch by the Apache Tailing Impoundments. A Field Investigation Data Report (Golder, 1997) was prepared to document soil borings, the installation of the Supplemental RI monitoring wells, and associated data collection activities during 1996. This data report summarized the procedures used to install and develop 11 new wells in the vicinity of the Apache Tailing Impoundments, and to collect and log samples during the drilling of the monitoring well boreholes.

Several subsequent activities not specifically identified in the Supplemental RI Sampling and Analysis Plan (SAP) or SAP Addendum have been performed during 1997 through 1999 in support of the Supplemental RI objectives. These activities include the following:

- installation of two groundwater monitoring wells;
- installation of three piezometers;
- drilling and geotechnical testing of tailing samples from one boring in the Main Impoundment;
- supplemental source characterization activities consisting of test pits in the North Impoundment and geochemical testing of tailing, foundation soils, and other material in or near the Main and North Impoundments;
- compositional/mineralogical analysis of brown oxide tailing and efflorescent surficial salt crusts;
- supplemental rainfall runoff sample collection and chemical analyses; and
- vertical specific conductance profiling in selected groundwater monitoring wells.

Data and information from these related investigations are included in the *Final Focused Feasibility Study* (FFS) (McCully, Frick & Gilman, Inc. [MFG], 2000).

A spring and tunnel survey was performed in the Apache Tailing Impoundments area during September 1996 as part of the Yak Tunnel (OU1) Routine Monitoring Program to monitor potential changes in hydrologic conditions in the vicinity of the Apache Tailing Impoundments area and Yak Tunnel (WESTEC, 1996). Springs identified during a previous survey in 1992 were monitored for flow rate, pH, specific conductance, and temperature. Of the three sites near the Apache Tailing Impoundments area with measurable discharge in 1992, two sites had an increased flow rate in 1996. One site with no visible discharge in 1992 had visible discharge during the 1996 survey, and one site had reduced discharge, although the flow rates were estimated. In addition, a reconnaissance survey of the California Gulch area was performed to identify, monitor, and sample new springs and mine shaft discharge sites that had developed since the previous survey in 1992. Nine new springs were identified in the Apache Tailing Impoundments area during the 1996 reconnaissance survey that were not previously identified, including three springs downgradient of the Main Impoundment. These sites were incorporated into the monitoring conducted during the Supplemental RI data collection activities.

Pursuant to an Action Memorandum issued by the EPA (EPA, 1997), Tailing Ponds Nos. 2 and 3 of the Apache Tailing Impoundments were addressed by a Time Critical Removal Action. The Removal Action was based on the Interim Removal Plan (MFG, 1997a). Tailing Ponds Nos. 2 and 3 and underlying foundation soils were removed by Asarco in 1997 and placed on the Main Impoundment. The areas were backfilled with imported clean borrow materials form the Hecla Borrow Pit (OU2) and regraded.

In 1999, Asarco installed wick drains in the Main Impoundment to facilitate dewatering of the subsurface slimes. The North Impoundment was backfilled to promote surface water drainage and reduce the potential for surface water infiltration. Asarco also started removing the material/tailing above the clay tile culverts and backfilling the North Impoundment pond with the excavated material.

In January of 2000, Asarco submitted the *Focused Feasibility Study, Apache Tailings Impoundments - Operable Unit 7 (OU7), California Gulch Superfund Site* (MFG, 2000), according to the terms of the CD. The FFS followed the general FS process (EPA, 1988), but relevant remedial alternatives were screened to produce a set of alternatives that were then analyzed in detail. The FFS provided a detailed analysis of the nine retained remediation alternatives from the SFS as applied to the Apache Tailing Impoundments, specifically to Main and North Impoundments.

A Proposed Plan describing the EPA's preferred alternative was issued on January 25, 2000 (EPA, 2000). The preferred alternative was Alternative 3A, Soil Cover with Geosynthetic Barrier.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Public participation is required by CERCLA Sections 113 and 117. These sections require that before adoption of any plan for remedial action to be undertaken by EPA, the State, or an individual (e.g., PRP), the lead agency shall:

1. Publish a notice and make the Proposed Plan available to the public; and

2. Provide a reasonable opportunity for submission of written and oral comments and an opportunity for a public meeting at or near the site regarding the Proposed Plan and any proposed findings relating to cleanup standards. The lead agency shall keep a transcript of the meeting and make such transcript available to the public. The notice and analysis published under item #1 above shall include sufficient information to provide a reasonable explanation of the Proposed Plan and alternative proposals considered.

Additionally, notice of the final remedial action plan set forth in the record of decision (ROD) must be published and the plan must be made available to the public before commencing any remedial action. Such a final plan must be accompanied by a discussion of any significant changes to the preferred remedy presented in the Proposed Plan along with the reasons for the changes. A response (Responsiveness Summary) to each of the significant comments, criticisms, and new data submitted in written or oral presentations during the public comment period must be included with the ROD.

EPA has conducted the required community participation activities through the presentation of the RI/FS and the Proposed Plan, a 60-day public comment period, a formal public hearing, and the presentation of the Selected Remedy in this ROD.

The Proposed Plan for Apache Tailing Impoundments (OU7) was released for public comment on January 25, 2000. The RI/FS documents and the Proposed Plan were made available to the public in the Administrative Record located at the EPA Superfund Records Center in Denver, the Lake County Public Library in Leadville, and the Colorado Mountain College Library in Leadville. Two notices of availability of these documents were published in the Herald Democrat on January 13 and January 20, 2000. A public comment period was held from January 25 to February 24, 2000. An extension to the public comment period was requested. As a result, it was extended to March 27, 2000.

On January 25, 2000, the EPA hosted a public meeting to present the Proposed Plan to the broader community audience than those that had already been involved at the site. The meeting was held at 7:00 p.m. in the Mining Hall of Fame and Museum in Leadville, Colorado. Representatives from Asarco presented the Proposed Plan, which discussed the following nine alternatives:

- Alternative 1: No Action
- Alternative 2A: Simple Soil Cover
- Alternative 2B: Simple Soil Cover and Groundwater Controls
- Alternative 2C: Simple Soil Cover (Alternate Surface Water Channel Alignment)

- Alternative 3A: Soil Cover with Geosynthetic Barrier
- Alternative 3B: Soil Cover with Geosynthetic Barrier and Groundwater Controls
- Alternative 3C: Soil Cover with Geosynthetic Barrier (Alternate Surface Water Channel Alignment)
- Alternative 4A: Removal and On-site Consolidation
- Alternative 4B: Removal with Disposal in an On-site Repository

The Soil Cover with a Geosynthetic Barrier was presented as the preferred alternative. A portion of the hearing was dedicated to accepting formal oral comments from the public. At this meeting, representative of EPA, CDPHE, and Asarco answered questions about the site and the remedial alternatives. EPA's response to oral and written comments received during the public comment period is included in the Responsiveness Summary, which is part of this ROD, and is designated Appendix A.

An alternate proposal, entitled "Project Technical and Business Plan, Leadville Pyrite Project" was submitted by MTAA, Limited, the owner of two parcels of property, which encompass the majority of the Main and North Impoundments, on March 23, 1999. This plan lacked specific data and information to satisfy the CERCLA and NCP requirements for the evaluation of remedial alternatives. The EPA and the CDPHE provided preliminary comments on this plan to MTAA Limited on April 4 and April 5, 2000, respectively. An additional public meeting was held on April 13, 2000 at the Mining Hall of Fame and Museum in Leadville, Colorado to allow MTAA Limited the opportunity to present their proposal and to provide additional information in response to agency comments. MTAA Limited's proposal was made available to the public in the Administrative Record located at the EPA Superfund Records Center in Denver and the Lake County Public Library in Leadville. The notice of availability of this document was published in the Herald Democrat on April 6, 2000. Representatives from the MTAA Limited presented their proposal for processing the Apache Tailing material to recover pyrite, silver, and gold. Public comments on MTAA Limited's proposal were accepted through April 17, 2000. Public comments received on this plan are included in the Responsiveness Summary.

4.0 SCOPE AND ROLE OF OPERABLE UNIT

The California Gulch Superfund Site covers a wide area (Figure 2). As with many Superfund sites, the problems at the California Gulch Superfund Site are complex. As a result, EPA established the following OUs for the division of liability in geographically-or media-based areas within the Site. The OUs are designated as:

OU1 Yak Tunnel/Water Treatment Plan
OU2 Malta Gulch Fluvial Tailing/Leadville Corporation Mill/Malta Gulch Tailing Impoundment
OU3 D&RGW Slag Piles/Railroad Easement/Railroad Yard and Stockpiled Fine Slag
OU4 Upper California Gulch
OU5 Asarco Smelter/Slag/Mill Sites
OU6 Starr Ditch/Penrose Dump/Stray Horse Gulch/Evans Gulch
OU7 Apache Tailing Impoundments
OU8 Lower California Gulch
OU9 Residential Populated Areas
OU10 Oregon Gulch
OU11 Arkansas River Valley Floodplain
OU12 Site-wide Water Quality

The Selected Remedy for OU7 addresses the controlling airborne tailing particles, erosion, and metal loading to surface water and groundwater. Remedial actions undertaken within OU7 are intended to be consistent with the remedial action objectives (RAO) and goals identified for the entire California Gulch Superfund Site and other OU investigations.

This decision document makes no determination on whether surface water or groundwater within OU7 requires remediation. Pursuant to the August 26, 1994 CD at this Site, (USDC, 1994) it was agreed that the decision on remediation of surface and groundwater site-wide (OU12) would be made only after remedies for source remediation were selected and implemented at each OU. As a result, specific water quality goals for surface water and groundwater have not been established at this time.

5.0 SUMMARY OF SITE CHARACTERISTICS

Site characterization to assess the general conditions of the Apache Tailing Impoundments area and to evaluate the nature and extent of contamination within OU7 is based on information presented in the *Final Tailings Disposal Area Remedial Investigation Report* (WCC, 1994), the *Final Surface Water Remedial Investigation Report* (Golder, 1996a), the *Final Hydrogeologic Remedial Investigation Report* (Golder, 1996b), the *Field Investigation Data Report for the Apache Tailings Supplemental Remedial Investigation* (Golder, 1997), and the results of field investigations conducted by MFG specifically to support the FFS (MFG, 2000). Additional data collection activities and evaluations were also performed as part of Asarco's response to comments on the FFS and response to comments from the Apache Tailing Technical Meetings (a series of meetings involving representatives from the EPA, CDPHE, Asarco, and Lake County).

5.1 TAILING IMPOUNDMENTS AND FOUNDATION SOILS

The following sections summarize the characteristics of the tailing impoundments comprising OU7, which include the Main Impoundment, Tailing Pond No. 2, Tailing Pond No. 3, and the North Impoundment. Impounded tailing is the only identified source material within OU7.

5.1.1 Physical Characteristics

The physical characteristics of the Main Impoundment, Tailing Ponds Nos. 2 and 3, and the North Impoundment are summarized below. The description of surface conditions, as it relates to the northern half of the Main Impoundment, pertains to the conditions noted prior to the consolidation of Tailing Ponds Nos. 2 and 3 onto the Main Impoundment.

5.1.1.1 Main Impoundment

The Main Impoundment covers an area of approximately 11.3 acres. Embankment slopes typically range from 1.5:1 (horizontal:vertical) to 1.75:1, and on the southwest embankment approach 1:1. Embankments range in height from approximately 15 feet on the north and east to 50 feet on the southwest. Materials on the embankment surface typically consist of medium- to coarse-grained sands, which are cemented to form a hard surface layer approximately 1-inch to 1-foot thick. The maximum observed thickness of tailing material is approximately 50 feet in the southwestern portion of the impoundment. The volume of tailing in the Main Impoundment was estimated at approximately 630,000 cubic yards (Golder, 1996c). Vegetation is not present on the Main Impoundment. Remnants of elevated open flumes constructed of wood are evident on the upper surface of the impoundment and many of the embankment faces.

Tailing material range in size from medium-grained sand to clay. Sand-size material predominates along the edges of the impoundment and silty clay-sized material predominates toward the center of the impoundment. Three distinct types of tailing occur in the impoundment. The uppermost weathered layer consists of oxidized, weathered sulfidic tailing to a depth of approximately 6 inches to 2 feet below the impoundment surface. The weathered sulfidic tailing, which occur in the North and Main Impoundments, are the most leachable and acid-generating

tailing, although total metal concentrations may be relatively low because of prior leaching. Underlying the uppermost weathered layer is a layer of dark gray tailing with generally high sulfidic content, which results in high acid generating potentials (AGP) and very negative acid-base accounts (ABA). The dark gray sulfidic tailing make up slightly less than half of the total volume of the Main Impoundment and the majority of the volume of the North Impoundment and Tailing Ponds Nos. 2 and 3. The tailing in the lower portion of the Main Impoundment has been characterized as brown oxide tailing. The brown oxide tailing, which occur only in the Main Impoundment, have oxide minerals characteristic of the milled ore, a very low sulfide content, and, with the exception of lead, have metal concentrations significantly less than the overlying dark gray sulfidic tailing, which have been derived from a different ore type. The brown oxide tailing has a significant average net neutralization potential, which neutralizes downward migrating acidic pond water.

Highly soluble evaporative/efflorescent metal salts, which are readily mobilized during precipitation events, are present on the surface of the Main Impoundment. Brown oxide tailing at the base of the Main Impoundment contain secondary sulfate, vanadate, phosphate, and oxide mineral phases, which are relatively insoluble in water. Additionally, some metals, such as zinc, are predominantly present in primary sulfide mineral phases within the brown oxide tailing, which are generally not subject to significant dissolution by sulfide oxidation due to the oxygen deficient environment beneath the Main Impoundment.

The Main Impoundment has perimeter berm on the top surface to prevent accumulated surface water from leaving the surface of the impoundment. The water ponds in the southern portion of the Main Impoundment where it subsequently evaporates, infiltrates, or is removed for treatment at the Yak Tunnel WTP. During the 1997 removal actions, a spray evaporation system was installed to reduce the volume of water potentially requiring treatment. As part of the 1997 removal actions, materials associated with Tailing Ponds Nos. 2 and 3 were placed on the northern half of the Main Impoundment.

5.1.1.2 Tailing Ponds Nos. 2 and 3

As previously discussed, Tailing Ponds Nos. 2 and 3 were removed during 1997 as part of an interim response action for OU7.

Tailing Pond No. 2 was located immediately west of the Main Impoundment and covered an area of approximately 1.5 acres. Tailing Pond No. 3 was located immediately downgradient and west of Tailing Pond No. 2 and covered an area of approximately 0.5 acres. Tailing Ponds Nos. 2 and 3 contained reprocessed surficial weathered tailing and dark gray sulfidic tailing originally obtained from the northwest portion of the Main Impoundment. The maximum observed thickness of tailing material in Tailing Ponds Nos. 2 and 3 during the removal action were approximated 14 and 6 feet, respectively. Vegetation did not exist on either impoundment. A total of approximately 40,000 cubic yards of material was removed from Tailing Ponds Nos. 2 and 3 including subsoils (alluvial material) and berms. The Tailing Pond Nos. 2 and 3 were backfilled with clean fill and graded to drain.

5.1.1.3 North Impoundment

The North Impoundment is located immediately north of the Main Impoundment and is separated from the Main Impoundment by an abandoned railroad grade. A sanitary sewer pipeline and an overhead electrical transmission line are currently located along the abandoned railroad grade between the North and Main Impoundments. The North Impoundment is approximately 1.8 acres in area with approximately two-thirds of the impoundment covered by as much as 8 to 12 feet of fill material. The remaining one-third of the tailing surface was exposed in the bottom of a closed basin with 4- to 10-foot high berms around the perimeter. In 1999, Asarco backfilled the North Impoundment to limit infiltration and promote surface water drainage with mine waste from OU9 and the top one foot with clean fill.

The maximum observed tailing thickness of 12.5 feet in the North Impoundment was noted in the south-central portion of the impoundment. Beyond the south-central portion of the impoundment, the tailing thickness decreases radially to 1.5 feet. Assuming a 5 foot average tailing depth, the approximate tailing volume is 14,500 cubic yards. The base of the tailing appears to reflect the topography of the native ground surface, which generally slopes upward to the north and northeast. The upper surface of the tailing appears to slope gently downward to the west.

The westward sloping surface and variations in texture suggest that the tailing were deposited from a discharge point located along the east end of the impoundment. The texture of the tailing becomes finer from east to west with tailing on the east half generally being sand size, whereas tailing on the west half consisting of clay- and silt-sized particles with some fine sand (silty/sandy slimes). The tailing are dark gray, unoxidized sulfidic tailing, with a very high sulfide content that results in very negative net acid-base potentials and high acid generating potentials. The dark gray sulfidic tailing in the North Impoundment have a sulfide content that is typically higher, and total metals concentrations that are substantially higher, than the dark gray sulfidic tailing in the Main Impoundment.

Laboratory grain size classification indicates that the sandy tailing are up to 70 percent medium-and fine-grained sand, and the clayey tailing are generally greater than 80 percent clay and silt-sized particles. With the exception of a relatively thin (approximately one-foot-thick) light-colored, oxidized layer on the surface, the tailing are relatively uniform vertically with only minor textural and color changes. The unoxidized, sulfidic tailing display dark shades of grey, whereas the thin upper oxidized layer of tailing display light shades of gray, yellow-red, and brown.

5.1.2 Geotechnical Evaluation

Two separate studies examined the physical and geotechnical properties of the Apache Tailing Impoundments and were performed in support of the site-wide Tailing RI (conducted in 1991) and the Apache Tailing Supplemental RI activities (conducted in 1996 and 1997). Data and information resulting from these studies provide a comprehensive characterization of the physical and geotechnical properties of the Apache Tailing Impoundments.

Numerous laboratory geotechnical tests were performed on tailing and underlying alluvium samples collected from the impoundment including: grain size analyses, hydrometer analyses, Atterberg limits, moisture content, specific gravity, natural dry density, direct shear, consolidation, triaxial shear, and permeability tests. The results of these tests are presented in the FFS (MFG, 2000) and summarized in Tables 1 through 3.

For the purpose of determining slope stability safety factors associated with regrading and capping the Apache Tailing Impoundments, a slope stability analyses for long-term static and dynamic (seismic) loading conditions at the Main Impoundment were presented in the *Draft Apache Tailings Feasibility Study* (Golder, 1996c). Cross-sections for long-term static analysis were selected at the Main Impoundment based on a combination of slope height, slope steepness, and anticipated loading situations. Two cross-sections were selected to represent critical combinations of these factors that would produce the critical sections for the evaluation and provide a slightly conservative estimate of stability at other locations around the impoundment perimeter. Calculated factors of safety for the southwest embankment of the Main Impoundment were 1.24 under static conditions and 1.14 under seismic conditions (Golder, 1996c). Calculated factors of safety for the north embankment of the Main Impoundment were 1.93 under static conditions and 1.69 under seismic conditions (Golder, 1996c).

Analysis of seismic liquification potential was conducted on varying soil types found within the impoundment by methods presented for sand to clayey soils. No soil type including slimes found at the Apache Tailing Impoundments classified as a liquefaction susceptible soil (MFG, 2000).

5.1.3 Geochemical Characteristics

The geochemical characteristics of the tailing and foundation soils are important in evaluating the significance of the individual metals loading sources, release mechanisms for contaminants, and contaminant transport. Based on uniquely different physical and geochemical characteristics, the tailing and foundation soils have been divided into four categories, which occur in the following general sequence from top to bottom when all types are present - weathered sulfidic tailing, dark gray sulfidic tailing, brown oxide tailing, and foundation soils. Briefly, the geochemical characteristics of the various potential source materials are summarized as follows:

- The weathered sulfide tailing, occurring on the surface of the North and Main Impoundments, are the most leachable and acid-generating tailing, although total metal concentrations may be lower than equivalent unweathered tailing because of prior leaching.

- The dark gray sulfidic tailing, which occur in the North and Main Impoundments, contain the highest metals concentrations, with the North Impoundment tailing containing substantially higher concentrations than the Main Impoundment tailing.

- The dark gray sulfidic tailing have a very high sulfide content that results in high acid generating potentials (AGP) and very negative acid-base accounts (ABA); however, some acid neutralization potential (ANP) is present.

- The brown oxide tailing, which occur only in the Main Impoundment, have oxide minerals characteristic of the milled ore and, with the exception of lead, have metal concentrations significantly less than the overlying dark gray sulfidic tailing, which appear to have been derived from a different ore type.

- The brown oxide tailing have a significant average net neutralization potential (i.e., ANP:AGP > 3:1).

- The metal concentrations and acid-base characteristics of the foundation soils are based on a limited dataset, are highly variable and may be affected by both tailing-related metal sources and naturally occurring sources.

The borings and test pits from which tailing and foundation soil samples have been collected and analyzed are listed in Table 4, and the locations of the sampled borings and test pits are shown on Figure 3. Analytical data for three surficial composite samples are presented in Table 5, and sample locations are shown in Figure 3. A select number of samples collected during the Tailing RI (WCC, 1994) were analyzed for a larger suite of metal analyses. These analyses, in addition to the parameters shown in Table 4, included: antimony, barium, beryllium, chromium, copper, manganese, mercury, nickel, silver, and thallium. The results of these analytes are summarized in Table 6.

The data used in the evaluation of the geochemical character of the tailing and foundation soils are summarized in Table 4, and include the following parameters:

- Total concentrations of arsenic, cadmium, lead, and zinc.
- Concentrations of arsenic, cadmium, lead, and zinc using the Synthetic Precipitation Leach Procedure (SPLP).
- Sulfur species (organic sulfur, pyritic sulfur, and sulfate sulfur).
- ANP
- AGP, based on pyritic sulfur
- ABA

5.1.4 Wind Erosion Potential

As is common for many types of tailing piles (Blowes et al., 1991), the Apache Tailing Impoundments appear to have formed a surface crust in many areas due to weathering. Because of this surface crust, the potential for wind erosion is significantly reduced and may only be a factor on embankment slopes and disturbed portions of the tailing piles. The tailing impoundment surfaces are also commonly wet, frozen, or snow-covered further reducing the potential for wind erosion.

5.1.5 Tailing Pond Water and Runoff

Two samples of water ponded on the Main Impoundment were collected and analyzed; the first sample was collected in September 1991 as part of the Surface Water RI (Golder, 1996a) and the second sample was collected in May 1997. Analytical data for the samples are presented in Table 7. As indicated in Table 7, the analyte concentrations are relatively high in the sample collected in 1991 (probably as a result of evapo-concentration). In contrast, the analyte concentrations are relatively low in the sample collected in 1997 (probably as a result of dilution by spring snowmelt).

A limited number of stormwater runoff samples have been collected along the outer embankment slopes of the Main Impoundment. Analytical data for these samples indicates high concentrations of dissolved metals and other parameter concentrations resulting from the presence of actively weathered acid-producing tailing on all outward facing Main Impoundment slopes. Although low-intensity precipitation events may not produce significant runoff, even small amounts of precipitation will liberate metals, which will subsequently be available for mobilization during more intense runoff events.

5.2 GROUNDWATER CONDITIONS

Hydrogeologic and hydrochemical conditions at the Apache Tailing Impoundments area have been characterized on the basis of information from 28 monitoring wells, 3 deep piezometers, 4 shallow mini-piezometers, and 6 borings. Locations of the monitoring wells, piezometers, and borings are shown in Figure 3.

Groundwater near the Apache Tailing Impoundments area occurs as pore water within tailing material, in unconsolidated sedimentary (glacial till and alluvium) deposits (the alluvial aquifer), and in unconsolidated bedrock (the bedrock aquifer). Pore water within the central portion of the Main Impoundment appears to be perched on top of relatively low permeability materials consisting of silty, clay tailing (i.e., slimes), and in some locations a low permeability, stiff, clayey layer. Coarser tailing located near the embankments of the Main Impoundment have relatively higher permeability compared to the slimes in the central portion of the impoundment and, thus, the vertical component of the flow for pore water is greater in the margins of the tailing impoundment than the central portions. Tailing in the North Impoundment are unsaturated, although clayey/silty tailing in the western portion of the impoundment have moisture contents approaching saturation. Unsaturated alluvium underlies the entire North Impoundment.

Unconsolidated sedimentary deposits, which are composed of glacial till and outwash sediments, and recent alluvium, overlie the bedrock aquifer. The alluvial aquifer is primarily composed of very poorly sorted, unstratified glacial till with a stiff clay matrix, which is interbedded with laterally discontinuous coarser-grained outwash deposits of silts, sands, and angular to subrounded gravels. Gravels, pebbles, and occasionally cobbles composed of granite, metamorphic and sedimentary rocks are present in the alluvial aquifer sediments. Alluvial aquifer sediments are at least 260 feet thick beneath the Apache Tailing Impoundments. Depth to groundwater in the alluvial aquifer ranges from approximately 34 feet bgs in monitoring well

AP1TMW17 (upgradient of the North Impoundment) to less than approximately one foot below ground surface in monitoring well AP1TMW2 (downgradient in the California Gulch channel).

In the Apache Tailing Impoundments area, groundwater generally flows from east to west in a direction that roughly follows the surface topography along the axis of Califomia Gulch. However, away from the topographic influence of California Gulch, the alluvial now is directed to the southwest.

The potentiometric surface in the alluvial aquifer periodically appears to be above the base of tailing in a relatively small area under the southwestern portion of the Main Impoundment; however, apparent confined or semi-confined conditions beneath the impoundment in the alluvial aquifer complicate interpretation of the potential for groundwater contact with the tailing (i.e., water level elevations measured in the wells may represent only the position of the potentiometric surface and not contact with tailing). Therefore, the area of actual hydrologic contact between tailing material and the alluvial aquifer may be non-existent or less extensive than the area of potential contact that would be estimated assuming unconfined aquifer conditions. The potentiometric surface has been periodically above the base of the tailing in only one well, AP1TMW11D. Based on monthly water level measurements from November 1996 through June 1999 the water level in this well was above the base of the tailing (by as much as 0.5 feet) during the spring and fall of 1997 and fall of 1998. Water level in other wells screened in the alluvial aquifer beneath the tailing have remained below the base of the tailing.

Although water levels in wells screened in the alluvial aquifer beneath the North Impoundment have remained below the base of the tailing from November 1996 through June 1999, the hydrograph for well AP1TMW14S indicates that a substantial groundwater mound develops in the spring and occasionally during other times of the year as a result of focused recharge of precipitation through the topographic depression in the North Impoundment (MFG, 2000).

Remediation of groundwater will be addressed at a later date, if necessary. EPA has agreed to establish specific groundwater requirements at a later date when EPA and CDPHE have determined the allowable water quality standards pursuant to OU12 (Site-wide Water Quality).

5.3 CONTAMINANT FATE AND TRANSPORT

Arsenic, cadmium, lead, and zinc were identified in the FFS as potential contaminants of concern (COC) for the evaluation of the remedial alternatives. The evaluation of the COCs in the Apache Tailing Impoundments area was based on the migration pathway model shown in Figure 4.

A loading mass balance model was developed to assess surface water loading rates and the relative contributions of metals to groundwater from various potential sources and the mechanisms of loading. The loading mass balance model was developed to account for flow, chloride, and the COCs, and a probabilistic sensitivity analysis of input parameters was performed to evaluate the potential variability in the model output. Copper was not included in the model because most of the analytical results were non-detect. Of the COCs, zinc is most useful in developing the loading mass balance and in evaluating the relative contributions from various sources because zinc is present at the highest concentrations in groundwater and tailing

and it is generally a geochemically conservative (i.e., non-reactive) metal considering site hydrochemical conditions. Findings of the site characterization work are summarized below:

Loading in surface water downstream of OU7 varies seasonally. The dissolved zinc load in surface water downstream of OU7 during the November 1996 low-flow period was approximately 139 pounds per day (lbs/day). During this period, approximately 89 percent of the surface water loading downstream of OU7 was attributed to springs downgradient of Tailing Ponds Nos. 2 and 3 (48 percent) and springs upgradient of OU7 (41 percent). Flow in California Gulch resulting primarily from discharge from the Yak Tunnel WTP accounts for most of the remaining load.

The dissolved zinc load in surface water downstream of OU7 during the June 1997 high-flow period was approximately 597 lbs/day. During high-flow, the majority (98 percent) of the surface water loading downstream of OU7 resulted from sources in Upper California Gulch (OU4) and Stray Horse Gulch (OU6). Approximately 2 percent (11.6 lbs/day) of the dissolved zinc load in surface water downstream of the Apache Tailing Impoundments area results from various sources (primarily springs) located in the area upgradient of the Main Impoundment. The remaining dissolved zinc load (14.0 lbs/day) in surface water downgradient of the Apache Tailing Impoundments area results from springs that are located downgradient of the Main Impoundment and former Tailing Ponds Nos. 2 and 3.

Collectively, stormwater flow from the Main Impoundment embankments and percolation through the North Impoundment and Tailing Ponds Nos. 2 and 3 account for approximately 95 percent of the dissolved zinc mass loading to groundwater in the Apache Tailing Impoundments area. The remaining sources of dissolved zinc mass loading to groundwater include upgradient groundwater flowing into the Apache Tailing Impoundments area (4 percent), percolation through the Main Impoundment (0.8 percent) and potential contact, if any, between shallow alluvial groundwater and the base of tailing (less than 0.1 percent). Other metals exhibit a similar loading pattern (MFG, 2000).

5.4 HISTORIC AND CULTURAL RESOURCES

During the survey by Foothill Engineering Consultants (Asarco, 1995), two cultural resources sites were identified within 100 feet surrounding the Apache Tailing Impoundments area: (1) the Apache Mill and Tailing Pond (Site 5LK890); and (2) structural remains (possibly the remnants of a stamp mill or other industrial activity) and artifacts scatter (Site 5LK891).

The mill and tailing pond site (5LK890) includes remnants of the former Apache Mill (mostly modern), located near the northwest cotner of the Main Impoundment, wooden slurry flume remnants, and two deteriorated (probable) pump houses. This site was recommended as not individually eligible for nomination to the National Register of Historic Places (NRHP), and not contributing to the Leadville Historic Mining District. The State Historic Preservation Officer (SHPO) concurred with the findings of the study and recommendations.

Site 5LK891, which includes structural remains and artifacts scatter on the south side of both the California Gulch channel and the Apache Tailing Impoundments, was recommended as

individually eligible for nomination to the NRHP under Criterion D, and contributing to the Leadville Historic Mining District. SHPO concurred with the findings and recommendations. Avoidance of the site was recommended (Asarco, 1995), however, if avoidance is not feasible, additional work, such as test excavations, additional archival research and/or oral interviews may be necessary to identify and document the nature and significance of the site.

6.0 CURRENT AND POTENTIAL FUTURE LAND USE

Land surrounding and within the California Gulch Superfund Site is predominately dedicated to mining, commercial, and residential uses. The Apache Tailing Impoundments are located within the area zoned for industrial use by the City of Leadville. The property within OU7 is not currently being utilized by any entity. Land within, and immediately surrounding, OU7 is privately owned by a variety of entities, with the exception being a small strip of property south of the Main Impoundment owned by the Bureau of Land Management.

Asarco owns two small parcels in the vicinity of the tailing impoundments: one to the south of the Main Impoundment; and the second near the eastern edge of the Main Impoundment in the area of monitoring wells APITMW13S and APITMW13D. The majority of the property on which the tailing impoundments are located is divided into at least five parcels, several of which were purportedly owned by Apache Energy & Minerals Company, the former operator of the Apache Mill where reprocessing operations were conducted. Two of these parcels, encompassing the majority of the Main and North Impoundments, were sold at public tax lien sales. The current owner of these properties is MTAA Limited.

Institutional controls will be established as part of the Selected Remedy to warn of potential hazards and to maintain the effectiveness of the remedy by limiting access to or use of the property (current and potential future land use scenarios), including temporary and permanent measures.

The State of Colorado Division of Water Resources, State Engineers Office (CDWR-SEO) has no authority to prevent any proposed water user who is entitled by all applicable laws from installing a groundwater well within the vicinity of the Apache Tailing Impoundments (OU7). Contoured groundwater contaminant concentration maps (for the COCs only) of the Apache Tailing Impoundments area (minimum 100 yard radius where applicable) will be provided to the CDWR-SEO. This is necessary and appropriate for the purpose of establishing a valid and effectual warning system in the interest of groundwater controls. This will provide the CDWR-SEO the appropriate information to enable them to disclose recent groundwater quality conditions and potential hazards associated with these groundwater contaminants to any potential well permitees. This will be provided, at a minimum, to facilitate protection of public health and the environment in relation to groundwater at the Apache Tailing Impoundments (OU7) until a ROD for Site-wide Water Quality (OU12) has been implemented.

Future land use of the OU7 site would be determined by the owners, consistent with local zoning, and subject to controls to maintain the protectiveness of the remedy and containment of the tailing.

7.0 SUMMARY OF SITE RISKS

Baseline risk assessments (RA) characterize potential human health and ecological risks at a site based on current conditions (i.e., no action taken at the site). Remedial action is driven in part by the potential for human health or ecological risk; the RA indicates the media and exposure pathways to be addressed. The human health and ecological RAs were conducted for the California Gulch Superfund Site as a whole site and not for the individual OUs. Therefore, the following RA summaries include information pertinent to the OU7 site. Contaminants, receptors, exposure pathways, and baseline risks at OU7 are described below.

7.1 HUMAN HEALTH RISKS

The following human health RAs are pertinent to OU7:

- *Preliminary Human Health Baseline Risk Assessment for the California Gulch NPL Site (*Roy. F. Weston, Inc. [Weston], 1991) (preliminary RA).

- *Baseline Human Health Risk Assessment for the California Gulch Superfund Site, Part C Evaluation of Worker Scenario and Evaluation of Recreational Scenarios* (Weston, 1995a) (final RA).

The preliminary RA (Weston, 1991) evaluated residential risks from exposure to contaminated media (i.e., soil, waste rock, tailing, etc). Since the completion of the preliminary RA, several studies were completed that provided additional data on contaminant concentrations and on human and ecological exposures. Additionally, Leadville officials and business leaders expressed concern over possible risks and liabilities associated with commercial and recreational uses within the California Gulch Superfund Site. The final baseline RA (Weston, 1995a) was composed of three parts: Part A evaluated residential risk from exposure to lead; Part B evaluated risk to residents from exposure to contaminants other than lead; and Part C, developed in response to community concerns, presented risk-based action levels to determine whether chemical concentrations presented a risk at locations used for commercial, industrial, or recreational purposes.

The following sections summarize the results of these RAs, including media and contaminants of concern, exposure assessment, and risk characterization, as they relate to OU7.

7.1.1 Media and Contaminants of Concern

Both the preliminary and final RAs indicate that soil is the medium of concern. Arsenic and lead were used as indicator contaminants for risk in the final RA (Weston, 1995a). These contaminants were selected based on the results of the preliminary RA (Weston, 1991), which indicate that lead and arsenic are responsible for the majority of human health risks at the California Gulch Superfund Site. Groundwater and surface water will be addressed as part of OU12.

7.1.2 Exposure Assessment

Residential use of OU7 does not currently occur, nor is future residential use reasonably anticipated. If residential use of OU7 occurs in the future, site risk would need to be reevaluated. Commercial, industrial, and recreational uses are expected at OU7 because the site is currently zone for industrial use. Therefore, receptors of concern at OU7 consist of commercial and industrial workers and recreational visitors.

The preliminary RA (Weston, 1991) identified potential primary sources of metals of concern, the mechanisms of release to the environment, and receptors in a conceptual site model, which is shown on Figure B-1 in Appendix B. The final RA (Weston, 1995a) identified soil ingestion as the exposure pathway of concern for recreational visitors; ingestion of soil and dust was identified as the exposure pathway of concern for commercial/industrial workers. Exposure to other media (e.g., slag piles) and exposure to soil/dust through other pathways (e.g., dermal) are considered of insignificant concern for workers and recreational users.

7.1.3 Risk Characterization

Rather than calculating risks for all COCs at the California Gulch Superfund Site, the final RA (Weston, 1995a) developed risk-based action levels for arsenic and lead. Arsenic and lead have been identified as the primary metals of concern related to potential human health risks at the California Gulch Superfund Site. These action levels represent risk-based chemical concentrations that are protective of human health and can be compared to contaminant concentrations in soil to identify areas of potential concern to commercial/industrial workers or recreational visitors. The action levels should be compared to the average concentration across the exposure area; they do not represent maximum allowable concentrations (i.e., concentrations not to be exceeded).

For commercial/industrial exposure, the soil action level for lead ranges from as low as 2,200 milligrams per kilogram (mg/kg) to as high as 19,100 mg/kg with central tendency values in the 6,100 to 7,700 mg/kg range. Soil action levels for arsenic based on commercial/industrial exposure range from 330 to 1,300 mg/kg, with central tendency values in the 610 to 690 mg/kg range.

For recreational exposure, the soil action level for lead ranged from as low as 5,000 mg/kg to as high as 85,000 mg/kg, depending on the input parameters. The nominal lead concentration for recreational exposure was 16,000 mg/kg. For arsenic, soil action levels for recreational exposure ranged from 1,400 to 3,200 mg/kg based on carcinogenic and systemic effects, respectively. The most appropriate arsenic concentration for use as a recreational action level was 1,400 mg/kg, based on the potential for carcinogenic effects.

The action levels are summarized below:

COC	Soil Action Levels, mg/kg	
	Commercial/Industrial	Recreational
Lead	6,100 - 7,700	16,000
Arsenic	610 - 690	1,400 - 3,200

As shown in Table 5, lead and arsenic concentrations in composite samples of surficial tailing range from 1,090 to 1,740 mg/kg and 257 to 343 mg/kg and, respectively. These concentrations are below the central tendency values for EPA risk-based action levels for both the commercial/industrial land use scenarios and the recreational use scenario identified final RA (Weston, 1995a). Therefore, the exposed tailing in their current condition do not pose a significant risk to human health.

7.2 ECOLOGICAL RISK

Baseline RAs characterizing ecological risks at OU7 consist of.

- *Final Baseline Aquatic Ecological Risk Assessment* (Weston, 1995b) (BARA).
- *Ecological Risk Assessment for the Terrestrial Ecosystem* (Weston, 1997) (ERA).

The BARA (Weston, 1995b) characterizes the impacts of mine waste contamination on the aquatic ecosystem of the California Gulch Superfund Site. The BARA provides a conceptual model of exposure at the California Gulch Superfund Site for aquatic receptors and identifies surface water and sediments as the exposure pathways of concern as these media are the most direct and significant means of exposure for receptors (see Figure B-2 in Appendix B). Data in the BARA were evaluated by sampling location rather than by OU.

Potential risks to the terrestrial ecosystem from mine waste contamination are characterized in the ERA (Weston, 1997). The EPA provides a conceptual site model for terrestrial receptors at the California Gulch Superfund Site and is shown in Figure B-3 in Appendix B. In the ERA, the potential for adverse effects was evaluated on a station by station basis and on an OU basis.

7.2.1 Media and Contaminants of Concern

The BARA (Weston, 1995b) identifies the potential for adverse effects to the aquatic ecosystem due to mine waste contamination and evaluates the ecological risks prior to and subsequent to the commencement of operations of the Yak WTP. Data from surface water and sediment sampling events in 1991 were used to represent the period prior to operation of the WTP, and data collected from 1992 to 1994 were considered for the time period subsequent to initiation of water treatment by the WTP. Contaminants evaluated in the BARA consist of aluminum, antimony, arsenic, barium, cadmium, copper, iron, lead, manganese, nickel, selenium, and zinc.

Media evaluated in the ERA for the terrestrial ecosystem included sediment, waste rock, surface soil, tailing, slag, and surface water; the media of concern varied by OU. Only data from the top two inches of media were evaluated in the ERA. Contaminants evaluated in the ERA consisted of antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, nickel, manganese, mercury, silver, thallium, and zinc.

7.2.2 Exposure Assessment

The BARA (Weston, 1995b) evaluated ecological receptors typical of those present or historically present at the California Gulch Superfund Site, consisting of aquatic plants, benthic macroinvertebrates, and fish (primarily trout species). The potential exposure pathways for aquatic receptors were ingestion of surface water, sediments, and dietary items, and direct contact with surface water, sediments, and modeled concentrations of dissolved contaminants in sediment pore water. Only the direct contact pathways were evaluated quantitatively.

An initial screening-level assessment was conducted based on data from individual sampling sites and from entire OUs. Metals concentrations were measured in tailing piles, mine waste piles, slag piles, surface soils, surface waters, and fluvial sediments. These media were considered likely pathways of exposure to biological receptors that would or could occur in the upland and/or wetland areas present in the Leadville area. The potential receptors in upland terrestrial habitats that were included in the risk assessment were bald eagle, red-tailed hawk, mountain bluebird, mule deer, least chipmunk, blue grouse, American kestrel, soil fauna (soil dwelling invertebrates), and plants.

The exposure pathways evaluated in the ERA consisted of direct exposure to contaminated media, incidental ingestion of contaminated media, and indirect exposure through the food chain. Contaminant intakes for the receptors evaluated were based on exposure assumptions such as food ingestion rates and body weight.

The ERA used the 95 percent upper confidence limit of the arithmetic mean (UCL) of contaminant concentrations in media to evaluate exposure and risks for each OU. If the maximum contaminant concentration was less than the 95 percent UCL, the maximum was used as the exposure point concentration.

7.2.3 Risk Characterization

The ERA (Weston, 1997) reviewed toxicological literature to derive acceptable contaminant intake values for birds and mammals. Resulting benchmark values, referred to as Toxicity Benchmark Values (TBV), were compared to calculated contaminant intakes for upland and riparian receptors.

To estimate risks, the ERA divided estimated intake by the TBV to derive a hazard quotient (HQ). Contaminant intakes greater than TBVs (HQ greater than one) indicated the potential for toxicity to the receptor. The sum of the HQs is the hazard index (141). HIs specific to terrestrial receptors in OU7 are presented below.

Results of the ERA indicated that several receptors in OU7 could have contaminant intakes greater than TBVs. Risk to the blue grouse, mountain bluebird, and least chipmunk, exceeded EPA acceptable levels for exposure to contaminants in tailing. Potential risks to plants and soil fauna from exposure to tailing were also indicated, although the risk to soil fauna was characterized as low, with no HQs exceeding 20. Surface water ingestion may also result in a potential risk of some effect to terrestrial receptors, based on the HQs calculated using data from 1993 and 1994 fall sampling events. Action levels were not developed for terrestrial receptors.

Hazard Indices for Receptors Exposed to All Solid Surficial Media in OU7			
Blue Grouse	Mountain Bluebird	American Kestrel	Least Chipmunk
6	277	1	28
Source: Weston, 1997			

The BARA (Weston 1995b) evaluated exposure pathway for aquatic receptors. The primary pathways addressed include ingestion of metals in surface water, sediments and dietary items and direct contact with metals in surface water, sediments, and modeled concentrations of dissolved metals in sediment pore water. Only the pathways including direct contact were quantitatively addressed in the BARA. Ecological receptors included aquatic plants, benthic macroinvertebrates, and fish (primarily trout species).

HQs and HIs specific to OU7 were not presented in the BARA; therefore, this summary does not provide quantitative risks associated with surface water in OU7. Results of the BARA (Weston 1995b) indicate that mine waste poses potential risk to all aquatic species. The BARA states that Apache Tailing Impoundments as well as other sources such as high metal waste rock piles, contribute to the metals entering California Gulch and, ultimately, the Arkansas River.

Loading from the Apache Tailing Impoundments area to groundwater (and not surface water) is currently the dominant process by which contaminants move from the site. This groundwater provides some loading to surface water downstream from OU7, which drains to California Gulch and ultimately to the Arkansas River. Response actions are necessary at OU7 to control the release of contaminants and acidic water into the environment. These releases currently present a risk to aquatic and terrestrial ecological receptors. Therefore, evaluation of OU7 remedial alternatives (Section 10) includes predicted reduction in metals loading to the groundwater system.

8.0 REMEDIAL ACTION OBJECTIVES

The remedy outlined in this ROD is intended to be the final remedial action for OU7. Preliminary qualitative RAO for tailing were developed in the SFS (EPA, 1993). The RAOs of the remedy presented in this ROD are:

- Control airborne transport of tailing particles;
- Control erosion of tailing materials and deposition into local water courses;
- Control leaching and migration of metals from tailing into surface water; and
- Control leaching and migration of metals from tailing into groundwater.

The effectiveness of the remedial action alternatives were evaluated with respect to these RAOs. In addition to these RAOs, the remedial alternatives were also evaluated with respect to the compatibility of the alternative with anticipated remedial actions in other operable units of the California Gulch Superfund Site. This California Gulch Site-wide compatibility was defined as controlling erosion and metal loading to surface water and groundwater that may adversely affect other operable units, and minimizing any potential adverse effects to other operable units caused by implementing the remedial alternative in OU7.

9.0 DESCRIPTION OF ALTERNATIVES

A wide range of cleanup options were considered in the SFS (EPA, 1993). Some of the alternatives were eliminated during preliminary screening because they would not effectively address contamination, could not be implemented, or would have had excessive costs. Remedial action alternatives for OU7 that were retained after screening alternatives from the SFS for the impounded tailing were evaluated in the FFS. All of the alternatives were evaluated using the nine criteria required by the NCP. This evaluation is described in the next section.

A brief description of the nine clean up alternatives that were considered in the FFS for the Apache Tailing Impoundments OU7 impounded tailing (MFG, 2000) is provided below.

Alternative 1: No Action

Estimated capital and operating cost: $0
Implementation time: Immediate

No remediation would take place under this alternative, in addition to the already completed cleanup measures under the Removal Action (removal of Tailing Ponds Nos. 2 and 3). This is the "no action" alternative required under CERCLA and is used as a baseline against which other alternatives are evaluated. The mass loading estimated for "existing" conditions includes Tailing Ponds Nos. 2 and 3 in the hydrologic system inflows and is used as the baseline for comparison of Alternatives 1, 2, 3, and 4. A mass loading estimate has been developed for Alternative 1 (No Action) to estimate the improvement to mass loading by taking no further action.

Alternative 2A: Simple Soil Cover

Estimated capital and operating cost: $3,6420,000
Implementation time: 2 years

This alternative would consist of regrading the tailing impoundment surface and embankments, and placing a soil cover. The regrading plan is presented on Figure 5. The simple soil cover would consist of a 6-inch coarse sand layer (for lateral drainage) under 18 inches of clean borrow soil. The cover would be revegetated with a mixture of native and introduced species adapted to the location. A typical section of the simple soil cover system is provided on Figure 7.

The channelization of California Gulch through the Main Impoundment would involve the excavation and relocation of approximately 55,000 cubic yards of tailing and underlying soil from the southern portion of the Main Impoundment. Excavation of the California Gulch channel, including removal of the clay-tile culverts and plugging the wooden box culvert, would be performed in conjunction with the regrading of the tailing impoundment surface. Tailing generated from the regrading/excavation operations would be placed on top of the Main Impoundment and in the area between the Main and North Impoundments to create a single combined tailing area. The new California Gulch channel would be designed to carry the 500-

year storm event and would convey flow from the valley floor upgradient of the Main Impoundment, as well as with flow from California Gulch upstream of OU7.

The maximum elevation of the regraded tailing is anticipated to be approximately 10,124 feet AMSL, which is approximately two feet lower than the current maximum elevation. All exterior embankments would be regraded to a maximum slope of 3:1 (horizonal:vertical). The north embankment of the modified California Gulch channel through the Main Impoundment would be further reduced to approximately 5:1 to achieve adequate stability in this area. Calculated minimum factors of safety for 3:1 slope exceed 3.0 under both static and pseudo-static (seismic) conditions. Calculated minimum factors of safety for the 5:1 slope exceed 2.1 and 1.6 under static and pseudo-static (seismic) conditions, respectively. These factors of safety indicate that the slopes and covers would be stable and reliable over long periods of time.

The sanitary sewer pipeline and an overhead electrical transmission line that are currently located along the abandoned railroad grade between the North and Main Impoundment (see Figure 5) would be relocated. The sewer system would be maintained as a gravity system.

In addition to the channelization of California Gulch, surface water controls under this alternative include constructing diversion ditches, as depicted on Figure 5. These ditches would be constructed to divert run-on from the surrounding areas, primarily the north and northeast, and convey this water to Starr Ditch to the west or the realigned California Gulch channel to the southeast.

The location of cultural resource site 5LK891 relative to the excavated channel is provided in Figure 6. This cultural site includes structural remains and artifact scatter and has been identified as eligible for nomination to the NRHP, and is considered contributing to the Leadville Historic Mining District, based on the potential for the site to yield historic information related to the site and Leadville. This site is not considered contributing as a landscape feature because it lacks sufficient physical and visual integrity. The structural remains are characterized as possibly the remnants of a stamp mill or other industrial activity. Excavation of the channel would impact this cultural resource site. Avoidance is not feasible. Following implementation of the data recovery plan upon consultation with the SHPO, other mitigation activities will be undertaken as appropriate.

Institutional controls would limit access to or use of the property (current and future use scenarios) or warn of potential hazards. Permanent measures to be considered would include legal or institutional mechanisms to provide notification that a barrier is in place and establish restrictions/requirements for future activities to maintain the integrity and effectiveness of the cover system and other control features. Modifications to County and/or city zoning ordinances would involve the creation of the “overlay district” to provide a screening process to identify properties where special precautions or requirements may be needed.

Alternative 2B: Simple Soil Cover with Groundwater Controls

Estimated capital and operating cost: $3,974,000
Implementation time: 2 years

Alternative 2B involves implementing the same actions as for Alternative 2A but includes additional groundwater controls intended to reduce the potential for contact between the alluvial groundwater and the base of tailing under the southwest portion of the Main Impoundment.

As with Alternative 2A, the impounded tailing would be graded and covered with a simple soil cover, consisting of 6-inch sand drainage layer, 18 inches of borrow soil, and vegetation. Channelization of California Gulch through the Main Impoundment would involve the excavation and relocation of tailing from the southern portion of the Main Impoundment. Excavation of the California Gulch, including removal of the clay-tile culverts and plugging of the wooden box culvert, would be performed in conjunction with the regrading of the tailing impoundment surface. Cultural resource site 5LK891 would be addressed as described for Alternative 2A, including implementation of a data recovery plan and other mitigation activities that may be required.

Groundwater controls would consist of a trench drain installed immediately downgradient of the Main Impoundment. The drain would be installed to a depth sufficient to influence the potentiometric surface beneath the Main Impoundment and, thereby, minimize the potential for contact of alluvial groundwater with the tailing base. It is estimated that a drain a minimum of 25 feet deep would be required to develop a 1.8-foot depression, or drawdown, of the potentiometric surface at monitoring well AP1TMW11D, in the area of potential groundwater contact. A 900-foot pipe length would be required (at a one percent slope), placing the discharge point near County Road 6.

Alternative 2C: Simple Soil Cover (Alternate Surface Water Channel Alignment)

Estimated capital and operating cost: $4,127,000
Implementation time: 3 years

Alternative 2C involves implementing the same remedial actions as for Alternative 2A including grading and covering the impounded tailing with a simple soil cover, consisting of 6-inch sand drainage layer, 18 inches of borrow soil, and vegetation. However, the difference is that in Alternative 2C the channel to convey California Gulch surface water through the southern portion of the Main Impoundment would be constructed further to the north than in Alternative 2A. This northern alignment would move the California Gulch channel back to its original pathway.

The regrading plan of the reconfigured area and the California Gulch channel alignment for Alternative 2C is shown on Figure 8. The channelization of California Gulch through the Main Impoundment would involve the excavation and relocation of approximately 85,000 cubic yards of tailing and underlying soil from the southern portion of the Main Impoundment. The extent of

the excavation required to construct the channel would encompass the majority of the current pond on the Main Impoundment. The channel would be constructed through the southern portion of the Main Impoundment, north of the existing wooden box as shown in Figure 8. Excavation of the California Gulch channel, including removal of the clay-tile culverts and plugging the wooden box culvert, would be performed in conjunction with the regrading of the tailing impoundment surface. At this location it would not feasible to excavate, or key, the base of the new channel into the underlying alluvium beneath the tailing, as would occur for the alignment included under Alternative 2A.

Tailing generated from the regrading/excavation operations would be placed on top the Main Impoundment and in the area between the Main and North Impoundments to create a single combined tailing area. The maximum elevation of the regraded tailing is anticipated to be approximately 10,130 feet AMSL, which is approximately four feet higher than the current maximum elevation.

Other components of Alternative 2C are identical to Alternative 2A.

Alternative 3A (Selected Alternative): Soil Cover with Geosynthetic Barrier

Estimated capital and operating cost: $4,078,000
Implementation time: 2 years

This alternative is identical to Alternative 2A except for utilization of a multi-layer cover instead of a simple soil cover system. The regrading plan of the reconfigured area is shown on Figure 5. The multi-layer composite cover would consist of 18 inches of clean borrow soil, placed over a geotextile drainage net (a filter fabric and a netlike configuration [geonet] for planar drainage of liquids) and geosynthetic barrier (i.e., a geosynthetic clay liner, which is a hydraulic barrier made of clay bonded to a geomembrane). The cover would be revegetated with a mixture of native and introduced species adapted to the location. A typical section of the simple soil cover system is provided on Figure 9.

Other components of Alternative 3C are identical to Alternative 2A.

Alternative 3B: Soil Cover with Geosynthetic Barrier and Groundwater Controls

Estimated capital and operating cost: $4,409,000
Implementation time: 2 years

Alternative 3B involves implementing the same actions as for Alternative 3A but include additional groundwater controls intended to reduce the potential for contact between the alluvial groundwater and the base of tailing under the southwest portion of the Main Impoundment (in the vicinity of well MW11S/D). The groundwater controls are identical to that discussed in Alternative 2B.

Alternative 3C: Soil Cover with Geosynthetic Barrier (Alternate Surface Water Channel Alignment)

Estimated capital and operating cost: $4,563,000
Implementation time: 3 years

Alternative 3C involves implementing the same remedial actions as for Alternative 3A. However, the difference is that in Alternative 3C the channel to convey California Gulch surface water through the southern portion of the Main Impoundment would be constructed further to the north. The alignment of the channel is identical to that discussed in Alternative 2C and is shown in Figure 8.

Alternative 4A: Removal and On-Site Consolidation

Estimated capital and operating cost: $12,060,000
Implementation time: 3 years

This alternative entails the complete removal of tailing material including a one- to two-foot layer of underlying soils from the Main and North Impoundments and transporting this material to an on-site consolidation area. An estimated volume of tailing and underlying soils to be removed is approximately 650,000 cubic yards.

A potential consolidation site is the Malta Gulch Tailing Impoundments (located in OU2) as shown on Figure 10. These impoundments are located on the south side of County Road 36, north of the former Arkansas Valley Smelter Site and approximately 2 miles west of the Apache Tailing Impoundments area. Significant improvements of the Malta Gulch Tailing Impoundment would be required prior to placement of material from the Apache Tailing Impoundments. These improvements on the Malta Gulch Tailing Impoundments, for example, might include rising the west and north embankments of the three impoundments an average 25 feet, utilizing approximately 100,000 cubic yards of clean fill material. A simple vegetated soil cover (as described in Alternative 2A) would be constructed over the consolidated tailing.

Following excavation in the Apache Tailing Impoundments area, regrading and/or placement of import fill material may be required to promote surface drainage and prevent ponding. Fencing and signage would be used to control access to the work areas. The final surface would be revegetated using native and introduced species adapted to the location. The new channel would be designed to carry the 500-year storm event.

Alternative 4B: Removal with Disposal in an On-Site Repository

Estimated capital and operating cost: $13,177,000
Implementation time: 3 years

This alternative entails the complete removal of tailing material including a one- to two-foot layer of underlying soils from the Main and North Impoundments and transporting this material

to a new repository located within the California Gulch Superfund Site boundary (on-site). An estimated volume of tailing and underlying soils to be removed is approximately 650,000 cubic yards.

The proposed repository is located in upper Oregon Gulch above, or southeast, of the Oregon Gulch Impoundment. This location identified on Figure 11 is outside of OU10 (Oregon Gulch) and within the overall boundary for OU9 (Residential Populated Areas). However, the proposed repository location is within the Lake County Industrial & Mining zoning districts.

Development of the repository site would be required to prepare the area to receive the tailing removed from the Apache Tailing Impoundments. The outline of the repository shown in Figure 11 is based on a maximum elevation of approximately 10,375 feet AMSL at the east end of the repository, with the top surface sloping to the west at a 3 percent slope to an elevation of 10,350 feet AMSL at the crest of a 3:1 slope, which would be constructed at the western end of the property. Based on these parameters, this repository site would cover approximately 24 acres and have an approximate capacity of 750,00 cubic yards. Following relocation and placement of the tailing in the repository, the area would be covered with a multi-layer cover as described in Alternative 3A.

Following excavation in the Apache Tailing Impoundments area, regrading and/or placement of import fill material may be required to promote surface drainage and prevent ponding. Fencing and signage would be used to control access to the work areas. The final surface would be revegetated using native and introduced species adapted to the location. The new channel would be designed to carry the 500-year storm event.

10.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 300.430(e)(9) of the NCP requires that the EPA evaluate and compare the remedial cleanup alternatives based on the nine criteria listed below. The first two criteria, (1) overall protection of human health and the environment and (2) compliance with applicable or relevant and appropriate requirements (ARAR), are threshold criteria that must be met for the Selected Remedy. The Selected Remedy must then represent the best balance of the remaining primary balancing and modifying criteria.

10.1 NCP EVALUATION AND COMPARISON CRITERIA

The following sections describe the NCP evaluation and comparison criteria.

10.1.1 Threshold Criteria

1. Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how potential risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or Institutional Controls.

2. Compliance with ARARs addresses whether or not a remedy will comply with identified federal and state environmental and citing laws and regulations.

10.1.2 Primary Balancing Criteria

3. Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time.

4. Reduction of toxicity, mobility and volume through treatment refers to the degree that the remedy reduces toxicity, mobility, and volume of the contamination.

5. Short-term effectiveness addresses the period of time needed to complete the remedy and any adverse impact on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

6. Implementability refers to the technical and administrative feasibilities of a remedy, including the availability of materials and services needed to carry out a particular option.

7. Cost evaluates the estimates capital costs, operation and maintenance (O&M) costs, and present worth costs of each alternative.

10.1.3 Modifying Criteria

8. State acceptance indicates whether the State (CDPHE), based on its review of the information, concurs with, opposes, or has no comment on the preferred alternative.

9. Community acceptance is based on whether community concerns are addressed by the Selected Remedy and whether or not the community has a preference for a remedy.

10.2 EVALUATING THE ALTERNATIVES WITH THE NCP CRITERIA

This section summarizes the evaluation of the Apache Tailing Impoundments OU7 tailing impoundment alternatives against the nine NCP criteria. The following subsections are a brief summary of the evaluation and comparison of the Apache Tailing Impoundments alternatives against each criteria. Additional details of the evaluation of the alternatives are presented in the FFS. Table 8 provides a comparison of the nine remedial action alternatives and the nine NCP criteria. Information for this section was obtained from the FFS for Apache Tailing Impoundments OU7 (MFG, 2000).

10.2.1 Overall Protection of Human Health and the Environment

This criterion is based on the level of protection of human health and the environment afforded by each alternative. All of the alternatives, except Alternative 1 (No Action), would provide adequate protection of human health and the environment. Because the "no action" alternative is not protective of human health and the environment, it is not considered further in this analysis as an option for this site.

Alternatives 2, 3, and 4 would provide significantly more protection from site risks than Alternative 1 (No Action) through the use of source control or removal measures. Alternative 1 would not be protective of human health and the environment because current conditions, even after removal of Tailing Ponds Nos. 2 and 3, continue to allow significant loading of metals to groundwater. Alternatives 2, 3, and 4 would provide protection of human health and the environment by meeting the RAOs for impounded tailing. Airborne transport of tailing and the potential for direct contact with precipitation and surface water runoff would be essentially eliminated under Alternatives 2, 3, and 4. However, the potential for contact, or some interaction, with surface water flowing in the constructed California Gulch channel alignment considered under 2C and 3C (the alternate northern alignment) may be slightly higher than with the alignment considered under Alternatives 2A and 3A because of its position relative to the base of the tailing. A soil cover with geosynthetic barrier (Alternatives 3A, 3B, 3C, and 4B) would provide a higher level of infiltration protection than a simple soil cover (Alternatives 2A, 2B, 2C, and 4A).

10.2.2 Compliance with Applicable or Relevant and Appropriate Requirements.

This criterion is based on compliance with the ARARs presented in Tables 9 through 11. Alternatives 2, 3, and 4 would comply with all of the ARARs.

10.2.3 Long-term Effectiveness and Permanence

Depending on the specific remedial action alternative, Alternatives 2, 3, and 4 would provide good to very good long-term effectiveness and permanence. Alternatives 2, 3, and 4 were assessed to be effective and reliable pertaining to risks and conditions associated with OU7 sources because of source controls or removal actions. Institutional controls for Alternatives 2 and 3 would ensure permanence of the remedy. In comparison to the Alternatives 2A and 3A, Alternatives 2B and 3B would provide essentially minimal to no enhancement of long-term effectiveness by incorporating groundwater controls. The existing minimal loading from the foundation soils under the Main Impoundment would likely continue even with a lowering of a potentiometric surface in this area. Constructing the channel to convey California Gulch further north (Alternatives 2C and 3C) would not result in any difference compared to Alternatives 2A and 3A as it relates to general source control characteristics, however, the channel embankment slopes would be slightly less stable. Alternatives 4A and 4B would provide similar degree of long-term effectiveness and permanence as Alternatives 2A and 3A, respectively.

10.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The remedial alternatives neither employ treatment techniques nor reduce toxicity or volume of impounded tailing. The alternatives would provide a reduction in mobility of metals from the impounded tailing to groundwater, surface water, and off site via arial transport. The predicted reduction in dissolved zinc loading to groundwater were calculated for each alternative and are summarized in Table 12. The reduction in metal loading was calculated by comparing existing conditions (i.e., prior to removal of Tailing Ponds Nos. 2 and 3) to predicted conditions for each alternative. Alternatives 4A and 4B having the greatest reduction followed closely by Alternatives 3A, 3B, and 3C.

10.2.5 Short-term Effectiveness

This criterion is based on the degree of community and worker protection offered, the potential environmental impacts of the remediation, and the time until the remedial action is completed. The short-term effectiveness would be moderate for Alternatives 2A, 2B, 3A, and 3B because of risk due to regrading of the tailing impoundment. Alternatives 2C and 3C would have a low to moderate short-term effectiveness because of additional risk during regrading tailing and working in wet tailing material. Alternatives 4A and 4B would pose the lowest short-term effectiveness during the removal and transportation of the tailing and underlying soil.

Additional risk to the community during implementation of Alternatives 2, 3, and 4 may result from dust emissions and increased road traffic. Short-term risk factors could be effectively managed with standard engineering controls during construction. Dust abatement is a commonly practiced construction method. Risk to workers during implementation of those alternatives may result from dust inhalation, contact with contaminated materials, and other industrial safety hazards. Dust generation would be mitigated using standard construction site watering and dust control practices. Contact with tailing by trained remediation workers would be minimal, because appropriate safety measures would be utilized.

Increased truck traffic and construction noise may result in some inconvenience to residents and businesses during the removal activities for Alternatives 4A and 4B.

Impacts to the environment during implementation of these remedial actions could potentially result from accidental discharge of runoff with suspended solids from tailing disturbed during construction. Potential problems would be minimized through the use of sediment control measures.

10.2.6 Implementability

This criterion is based on the ability to perform construction and implement administrative actions. Alternatives 2, 3, and 4 are administratively implementable, although they would require access from the current property owners. The construction technologies used in Alternatives 2, 3, and 4 are commonly used and widely accepted. Materials and personnel would be readily available for this type of work. The geosynthetic installation (Alternatives 3A, 3B, 3C, and 4B) may require specialized equipment and trained personnel.

Alternatives 2A and 3A are most readily implementable. Alternatives 2B and 3B present additional construction challenges for the groundwater control system. Alternatives 2C and 3C have additional difficulties associated with channeling California Gulch further north and require excavating into the deepest portion of the Main Impoundment. Alternatives 4A and 4B would be the most difficult to implement due to excavating and transporting a large volume of material in addition to preparing cooperative agreements with owners of the consolidation or repository site.

10.2.7 Cost

The estimated present worth costs for the alternatives, not including the No Action alternative, range from $3.6 million for Alternative 2A to $13.2 million for Alternative 4B. The cost of each alternative increases as the degree of containment increases. Cost summaries can be found in Table 8.

10.2.8 State Acceptance

The State has been consulted throughout this process and concurs with EPA's preferred alternative.

10.2.9 Community Acceptance

Public comment on the RI/FS and Proposed Plan was solicited during a formal public comment period extending from January 25 to March 27, 2000. The community is generally supportive of EPA's preferred alternative (Soil Cover with Geosynthetic Barrier).

EPA received an alternate proposal from MTAA Limited for consideration. MTAA Limited's proposal generally described processing the Apache Tailing Impoundments material to produce pyrite. Public comment on this proposal was accepted through April 17, 2000.

11.0 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by the site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

The source materials identified at the OU7 site include tailing and foundation soils. These source materials were divided into four categories - weathered sulfidic tailing, dark gray sulfidic tailing, brown oxide tailing, and foundation soils. These source materials do not constitute principal threat wastes; hence, they are considered non-principal threat wastes. Containment of the source materials utilizing a soil cover with a geosynthetic cover is a reliable remedy.

12.0 SELECTED REMEDY

Pursuant to an Action Memorandum issued by the EPA (EPA, 1997), Tailing Ponds Nos. 2 and 3 of the Apache Tailing Impoundments were addressed by a Time Critical Removal Action. The Removal Action was based on the *Interim Removal Action Plan* (MFG, 1997a). Tailing Ponds Nos. 2 and 3 and underlying soils were removed by Asarco during July and August 1997 and placed on the Main Impoundment. No further action is required at Tailing Ponds Nos. 2 and 3. The *Removal Action Completion Report* (MFG, 1997b) documents the Removal Action and related activities.

12.1 RATIONALE FOR SELECTED REMEDY

Based upon consideration of CERCLA requirements, the detailed analysis of alternatives, and public comments, EPA has determined that the Soil Cover with Geosynthetic Barrier alternative presented in the Proposed Plan, with no modifications, is the appropriate remedy for the Apache Tailing Impoundments within OU7. Alternative 3A either meets or exceeds benefits associated with the selecting criteria compared to the majority of the other alternatives. This Selected Remedy will reduce risk to human health and the environment through the following:

- As required, Alternative 3A meets the threshold cleanup evaluation criteria (overall protection of human health and the environment, and compliance with ARARs).
- Alternative 3A provides very good long-term effectiveness and permanence.
- Alternative 3A eliminates airborne transport of tailing particles and minimizes both the erosion of tailing materials and deposition into local water sources.
- Alternative 3A controls the risks (defined by the risk assessment) including ingestion of surface tailing by wildlife, contact of plants and soil fauna with surface tailing, ingestion of surface water potentially impacted by the tailing by wildlife, and exposure to commercial and industrial workers and recreational visitors.
- Alternative 3A is readily implementable. The remediation technologies selected for this alternatives have been successfully employed at other Superfund sites.

The Selected Remedy best meets the entire range of selection criteria and achieves, in EPA's determination, the appropriate balance considering site-specific conditions and criteria identified in CERCLA and the NCP, as provided in Section 13.0, Statutory Determinations.

12.2 DESCRIPTION OF SELECTED REMEDY

Alternative 3A: Soil Cover with Geosynthetic Barrier

This alternative includes the following components: (1) the application of source surface controls to the impounded tailing, consisting of regrading, placement of a multi-layer composite cover, and vegetating the covered surface; (2) surface water controls, including channelization of California Gulch through the southern portion of the Main Impoundment and construction of diversion ditches to provide surface water run-on and run-off controls; and (3) institutional controls.

The multi-layer composite cover would consist of 18 inches of clean borrow soil, placed over a geotextile drainage net and geosynthetic barrier (e.g., a geosynthetic clay liner). A minimum 12-inch thickness of the upper tailing surface would be compacted to provide a stable surface for cover construction. The cover would be revegetated with a mixture of native and introduced species adapted to the location (MFG, 2000). A typical section of the multi-layer soil cover system is provided on Figure 9.

The channelization of California Gulch through the Main Impoundment would involve the excavation and relocation of approximately 55,000 cubic yards of tailing and underlying soil from the southern portion of the Main Impoundment. Excavation of the California Gulch channel, including removal of the clay-tile culverts and plugging the wooden box culvert, would be performed in conjunction with the regrading of the tailing impoundment surface. Tailing generated from the regrading/excavation operations would be placed on top the Main Impoundment and in the area between the Main and North Impoundments to create a single combined tailing area. The new channel would be designed to carry the 500-year storrn event and would convey flow from the valley floor upgradient of the Main Impoundment, along with now from California Gulch upstream of OU7.

The maximum elevation of the regraded tailing is anticipated to be approximately 10,124 feet AMSL, which is approximately two feet lower than the current maximum elevation. All exterior embankments would be regraded to a maximum slope of 3:1 (horizontal:vertical). The north embankment of the modified California Gulch channel through the Main Impoundment would be further reduced to approximately 5:1 to achieve adequate stability in this area. Calculated minimum factors of safety for 3:1 slope exceed 3.0 under both static and pseudo-static (seismic) conditions. Calculated minimum factors of safety for the 5:1 slope exceed 2.1 and 1.6 under static and pseudo-static (seismic) conditions, respectively.

The sanitary sewer pipeline and an overhead electrical transmission line are currently located along the abandoned railroad grade between the North and Main Impoundment (see Figure 5). Under this alternative, these utilities would be rerouted, beginning at the existing manhole and pole at the northeast corner of the Main Impoundment, around the northern extent of the tailing area and tied back in with existing manholes and poles near the area where Starr Ditch jogs to the west, at the northwest corner of the Main Impoundment. The sewer system would be maintained as a gravity system.

In addition to the channelization of California Gulch, surface water controls under this alternative include constructing diversion ditches, as depicted on Figure 5. These ditches would be constructed to divert run-on from the surrounding areas, primarily the north and northeast, and convey this water to Starr Ditch to the west or the California Gulch to the southeast.

Institutional controls would limit access to or use of the property (current and future use scenarios) or warn of potential hazards. Permanent measures to be considered would include legal or institutional mechanisms to provide notification that a barrier is in place and establish restrictions/requirements for future activities to maintain the integrity and effectiveness of the cover system and other control features. Modifications to County and/or city zoning ordinances would involve the creation of the "overlay district" to provide a screening process to identify properties where special precautions or requirements may be needed. Land use and plan/proposal for future land use would be monitored and evaluated as part of the five year review process.

The CDWR-SEO has no authority to prevent any proposed water user who is entitled by all applicable laws from installing a groundwater well within the vicinity of the Apache Tailing Impoundments (OU7). Contoured groundwater contaminant concentration maps (for the COC only) of the Apache Tailing Impoundments area (minimum 100 yard radius where applicable) will be provided to the CWDR-SEO. This is necessary and appropriate for the purpose of establishing a valid and effectual warning system in the interest of groundwater controls. This will provide the CDWR-SEO the appropriate information to enable them to disclose recent groundwater quality conditions and potential hazards associated with these groundwater contaminants to any potential well permitees. This will be provided, at a minimum, to facilitate protection of public health and the environment in relation to groundwater at the Apache Tailing Impoundments (OU7) until a ROD for Site-wide Water Quality (OU12) has been implemented.

The long-term monitoring program will be developed during the remedial design and will include surface water and groundwater monitoring for the performance of the Alternative 3A. The potential monitoring locations that may be used are listed in Table 13. Although the specific water quality goals for site surface water and groundwater (i.e., OU12) has not been established at this time, a preliminary list of the laboratory analytical parameters that may be used are as follow:

- Total Alkalinity
- Calcium
- Chloride
- Magnesium
- Potassium
- Sodium
- Sulfate
- Arsenic
- Cadmium
- Copper
- Iron

- Lead
- Manganese
- Zinc
- Total Dissolved Solids
- Total Suspended Solids

The O&M program will be developed during the remedial design. O&M activities will involve inspection and maintenance of the cover and surface water controls. At a minimum, inspection of the site will include evidence of erosion, differential settlement of the cover, and vegetation monitoring.

12.3 ESTIMATED REMEDY COSTS

The detailed cost estimate and present worth analysis for Alternative 3A, the Selected Remedy, are presented in Tables 14 and 15, respectively. The net present value of the estimated capital and operating cost for a 30 year period is approximately $4.1 million. The time frame to implement the remedy is anticipated to be two years. The information in this cost estimate table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Difference, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.4 EXPECTED OUTCOME OF THE SELECTED REMEDY

The Selected Remedy for OU7 would make the Apache Tailing Impoundments a permanent waste management area. Exposure of source materials would be controlled through the use of engineering and institutional controls only. The anticipated environmental and ecological benefits would help restore the quality of groundwater, environmental conditions in California Gulch, minimize surface water impacts during storm events, and eliminate direct contact to humans and fauna.

12.5 CONTINGENCY MEASURES

Specific water quality goals for surface streams and heavy metals contamination have not been established at this time. EPA has agreed to establish specific surface and groundwater requirements at a later date when EPA and CDPHE, have determined the allowable water quality standards pursuant to OU12 (Site-wide Water Quality).

Pre-remedial data will be compared to water quality data collected after the Selected Remedy has been implemented. An evaluation of the degree of surface water-quality improvement will be made by EPA and CDPHE at that time. If the improvement in the California Gulch surface water and groundwater quality is not considered sufficient to meet OU12 water quality standards, additional response actions may be required.

The Selected Remedy will be designed to minimize active maintenance requirements. Post-closure maintenance of the cover and diversion channels will be used to ensure that the integrity and permanence of the cover and diversion channels are maintained. Provisions for surveillance and repair will be established as well as success measures for vegetation.

13.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, EPA must select a remedy that is protective of human health and the environment; that complies with ARARs; is cost effective; and utilizes permanent solutions, alternative treatment technologies, or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that include treatment which permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element. The Selected Remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. In narrowing the focus of the FFS, treatment of the Apache Tailing Impoundments was determined to be technically and economically impracticable. The following sections discuss how the Selected Remedy meets statutory requirements.

13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Selected Remedy protects human health and the environment through the prevention of direct contact with contaminants at the site. The Selected Remedy uses engineered covers to effectively reduce direct contact, ingestion, and inhalation of all contaminants. The reduction in total loading of zinc to groundwater is estimated to be 96 percent resulting from implementation of the Selected Remedy.

Potential risk to the terrestrial ecosystem due to ingestion of or exposure to impounded tailing will be eliminated by the Selected Remedy for the same reasons stated above.

13.2 COMPLIANCE WITH ARARs

The Selected Remedy will comply with all ARARs identified in Tables 9, 10, and 11. No waiver of ARARs will be necessary. Final performance standards will not include ARARs for Site-wide surface and groundwaters or require a specified decrease in point or nonpoint source loadings of COCs to Site-wide surface and groundwaters (USCD, 1994). It was agreed that the decision on remediation of Site-wide Water Quality (OU12) would be made between the EPA and the PRPs and codified in the CD only after remedies for source remediation were selected and implemented at each OU. As a result, specific water quality goals for surface streams and groundwater have not been established at this time.

13.3 COST EFFECTIVENESS

EPA has determined that the Selected Remedy is cost effective in mitigating the principal risks posed by contaminated tailing. Section 300.430(f)(ii)(D) of the NCP requires evaluation of cost effectiveness. Overall effectiveness is determined by the following three balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; and short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost effective. The Selected Remedy meets the criteria and provides for overall effectiveness in proportion to its cost. The estimated cost for the Selected Remedy is $4.1 million. The cost estimate includes annual inspection of the cover.

To the extent that the estimated cost of the Selected Remedy exceeds the cost for other alternatives, the difference in cost is reasonable when related to the greater overall effectiveness achieved by the Selected Remedy.

13.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES (OR RESOURCE RECOVERY TECHNOLOGIES) TO THE MAXIMUM EXTENT POSSIBLE

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions can be utilized in a cost effective manner at the Apache Tailing Impoundments.

Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy for the Apache Tailing Impoundments provides the best balance in terms of long-term effectiveness and permanence, treatment, implementability, cost, and state and community acceptance.

While the Selected Remedy for the tailing impoundment does not utilize treatment or removal, the use of engineered covers provides a long-term effective and permanent barrier to contaminated waste materials, thus reducing risk to a near equivalent extent.

13.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

Various treatment options for impounded tailing were considered early in the FS process; however, due to the nature and size of the impounded tailing, these options were determined to be either technically impracticable and/or not cost-effective (EPA, 1993).

13.6 FIVE-YEAR REVIEW REQUIREMENTS

Because the Apache Tailing Impoundments will remain on site, the Selected Remedy will require a five-year review under Section 121(c) of CERCLA and Section 300.430(f)(4)(ii) of the NCP. The five-year review includes a review of the groundwater and surface water monitoring data, inspection of the integrity of the cap, and an evaluation as to how well the Selected Remedy is achieving the RAOs and ARARs that it was designed to meet.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Selected Remedy is the second response action to be taken at OU7 of the California Gulch Superfund Site. The first action implemented the Action Memorandum (EPA, 1997) for a Time Critical Removal Action for Tailing Ponds Nos. 2 and 3. Tailing Ponds Nos. 2 and 3 and underlying soils were removed by Asarco during July and August 1997 and placed on the Main Impoundment. This removal action was consistent with the Selected Remedy for the Apache Tailing Impoundments.

In 1999, wick drains were installed in the Main Impoundment to facilitate dewatering of the subsurface slimes. The North Impoundment was backfilled and overall regrading was performed to promote surface water drainage. In addition, Asarco started excavating the material/tailing above the clay tile culverts and backfilled the excavated material at the North Impoundment pond. The 1999 work was consistent with the Selected Remedy for the Apache Tailing Impoundments.

The Proposed Plan for the Apache Tailing Impoundments was released for public comment on January 25, 2000. The Proposed Plan identified Alternative 3A, Soil cover with a Geosynthetic Barrier as the preferred alternative. Comments were received during the public comment period. Subsequently, the EPA determined that no significant changes to the remedy, as it was originally identified in the Proposed Plan, were necessary or appropriate.

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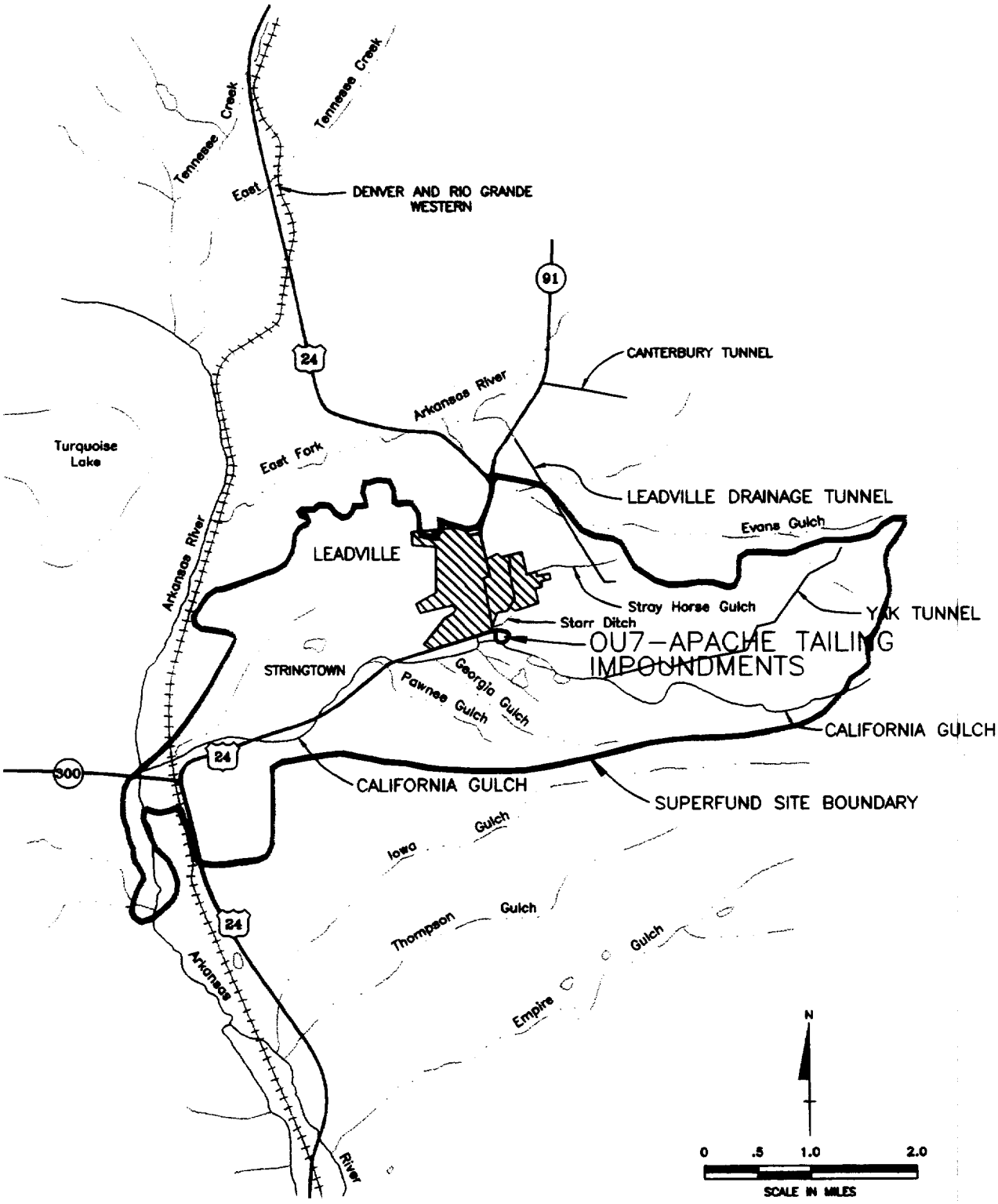
FIGURES



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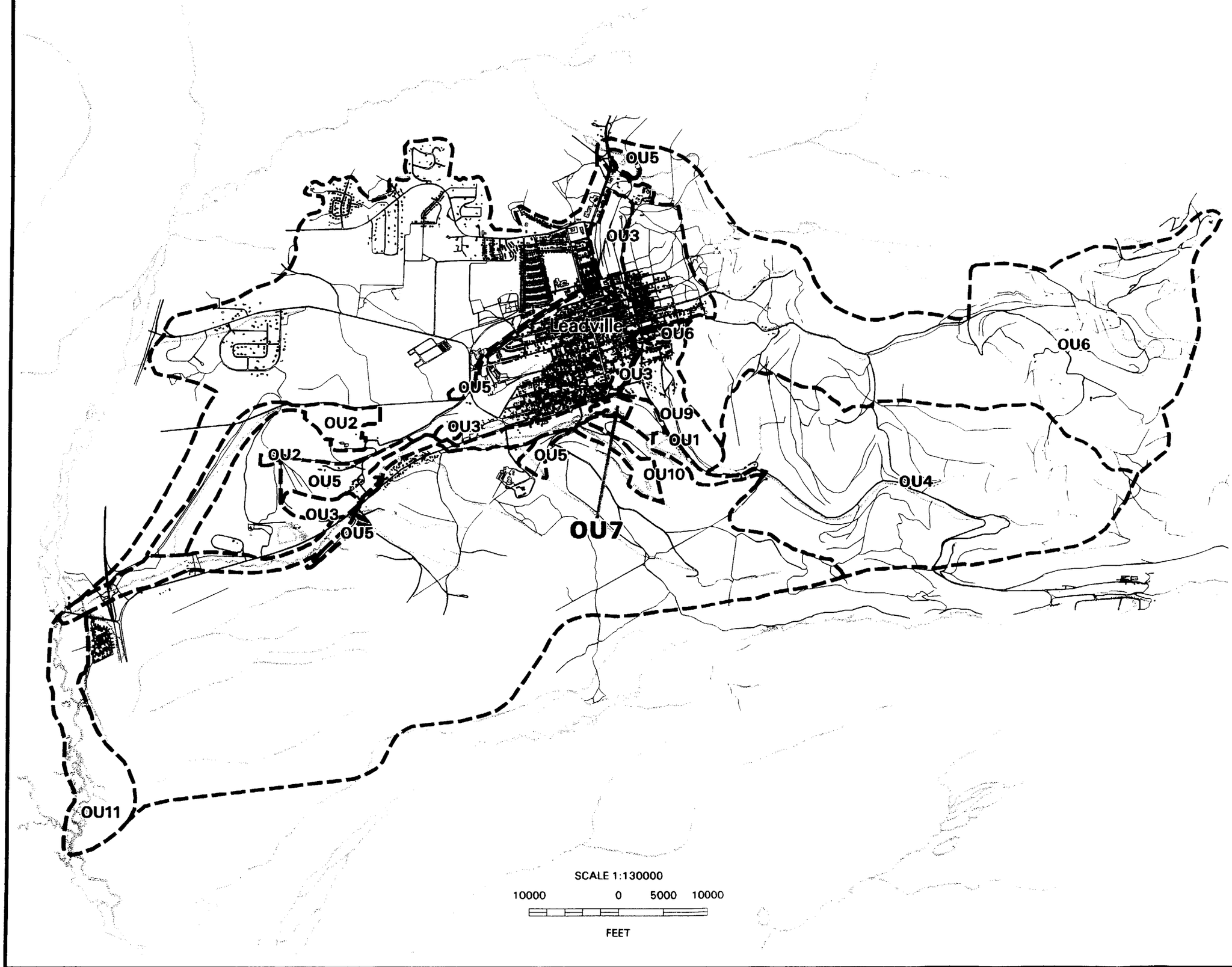
SOURCE: MFG, 2000

Figure 1

GENERAL SITE LOCATION MAP

California Gulch Superfund Site
Leadville, Colorado



Operable Units

OU1 - Yak Tunnel/Water Treatment Plant

OU2 - Malta Gulch Fluvial Tailing/Leadville Corp. Mill/Malta Gulch Tailing Impoundments

OU3 - D&RG Slag Piles/Railroad Easement/ Railroad Yard

OU4 - Upper California Gulch

OU5 - Asarco Smelters/Slag Mill Sites

OU6 - Starr Ditch/Penrose Dump/ Stray Horse Gulch/Evans Gulch

OU7 - Apache Tailing Impoundment

OU8 - Lower California Gulch

OU9 - Residentail Populated Areas

OU10 - Oregon Gulch

OU11 - Arkansas River Valley Floodplain

OU12 - Site Water Quality

— — Operable Unit Boundary

N

Figure 2

California Gulch Superfund Site and Operable Units Leadville, Colorado

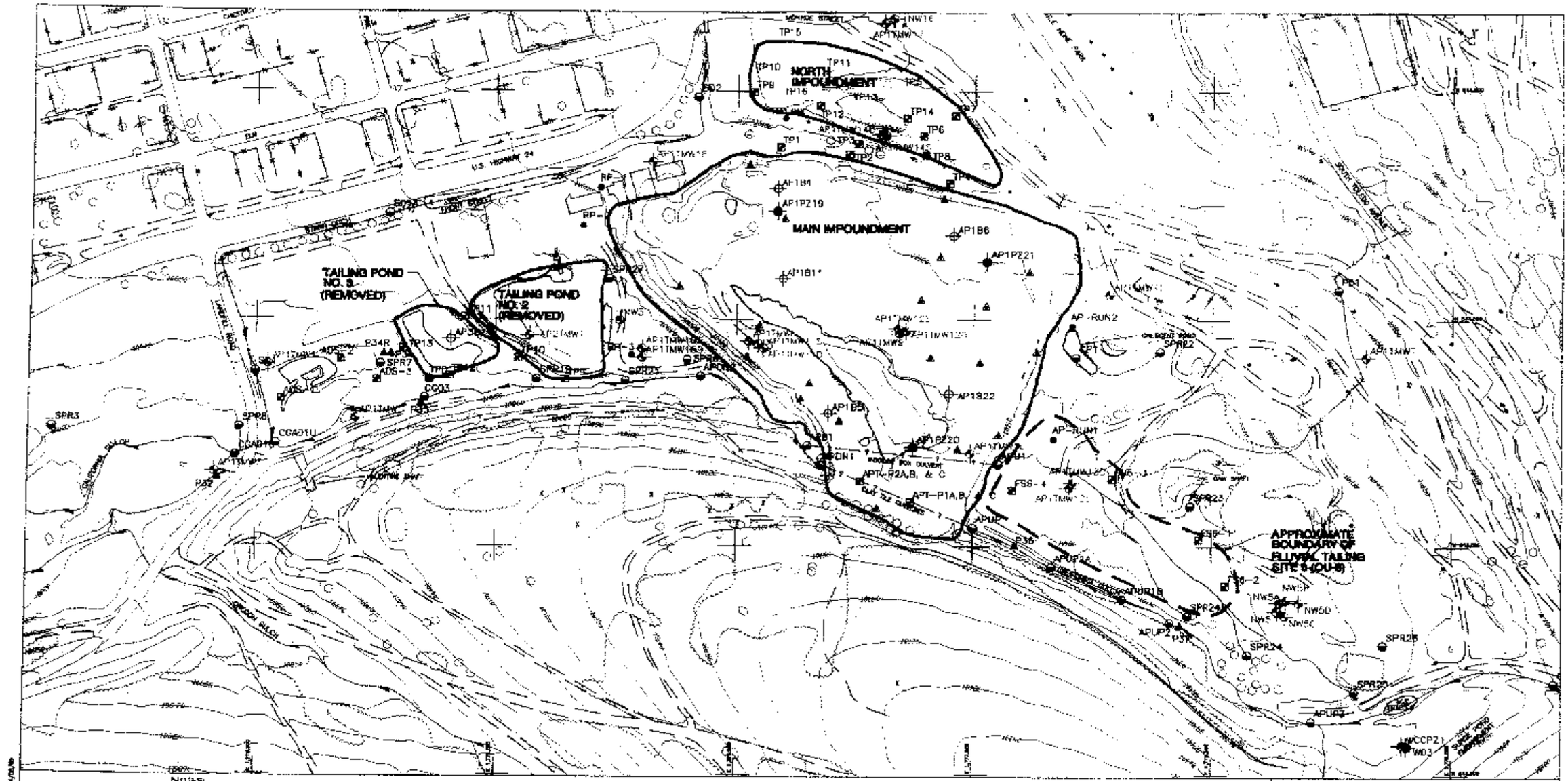
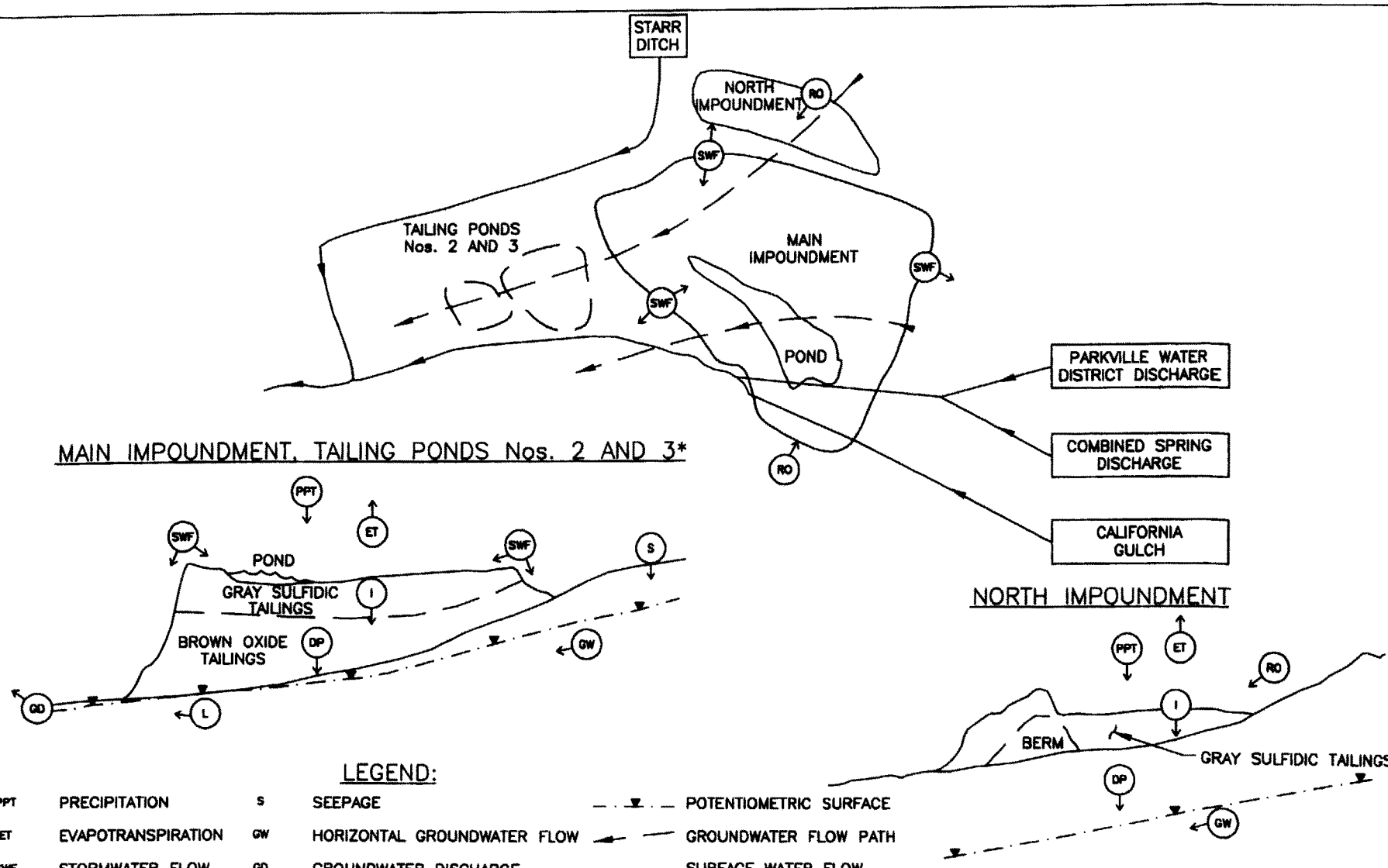


Figure 3

OU7 APACHE TAILING IMPOUNDMENTS DATA LOCATIONS

California Gulch Superfund Site
Leadville, Colorado



LEGEND:

PPT	PRECIPITATION	S	SEEPAGE		POTENTIOMETRIC SURFACE
ET	EVAPOTRANSPIRATION	GW	HORIZONTAL GROUNDWATER FLOW		GROUNDWATER FLOW PATH
SWF	STORMWATER FLOW	GD	GROUNDWATER DISCHARGE		SURFACE WATER FLOW
I	INFILTRATION	L	POTENTIAL LEACHING		
DP	DEEP PERCOLATION				
RO	RUN-ON				

NOTE:

1. THIS DRAWING IS NOT TO SCALE.
2. BROWN OXIDE TAILINGS ARE NOT PRESENT IN TAILING PONDS NO. 2 AND 3.
3. EVALUATIONS RELATED TO STORMWATER FLOW ARE DISCUSSED IN DETAIL IN FFS, APPENDIX B.

SOURCE: MFG, 2000

Figure 4

MIGRATION PATHWAY MODEL

California Gulch Superfund Site
Leadville, Colorado

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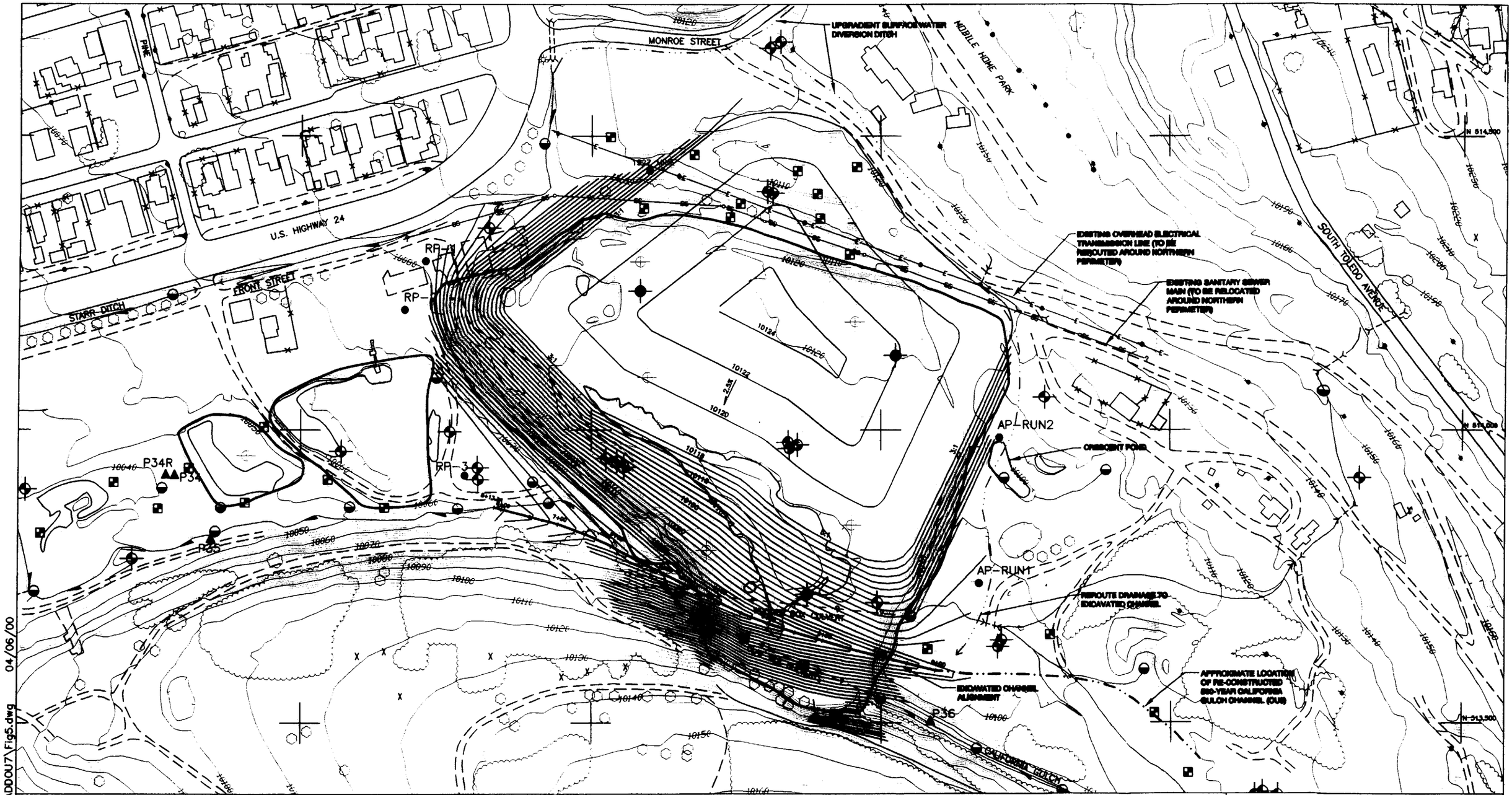

NOTE:
1. REGRADED SURFACE TOPOGRAPHY AT 2' CONTOUR INTERVALS

EXPLANATION

SURFACE WATER SAMPLE LOCATION	PAVED ROAD
GROUNDWATER MONITORING WELL	GRAVEL ROAD
SOIL BORING	WATER
MINI-PIEZOMETER	BUILDING/STRUCTURE
PIEZOMETER LOCATION	POWER POLE
SURGE POND WELL/PIEZOMETER	

N

SCALE: 1" = 200'

SOURCE: MFG, 2000

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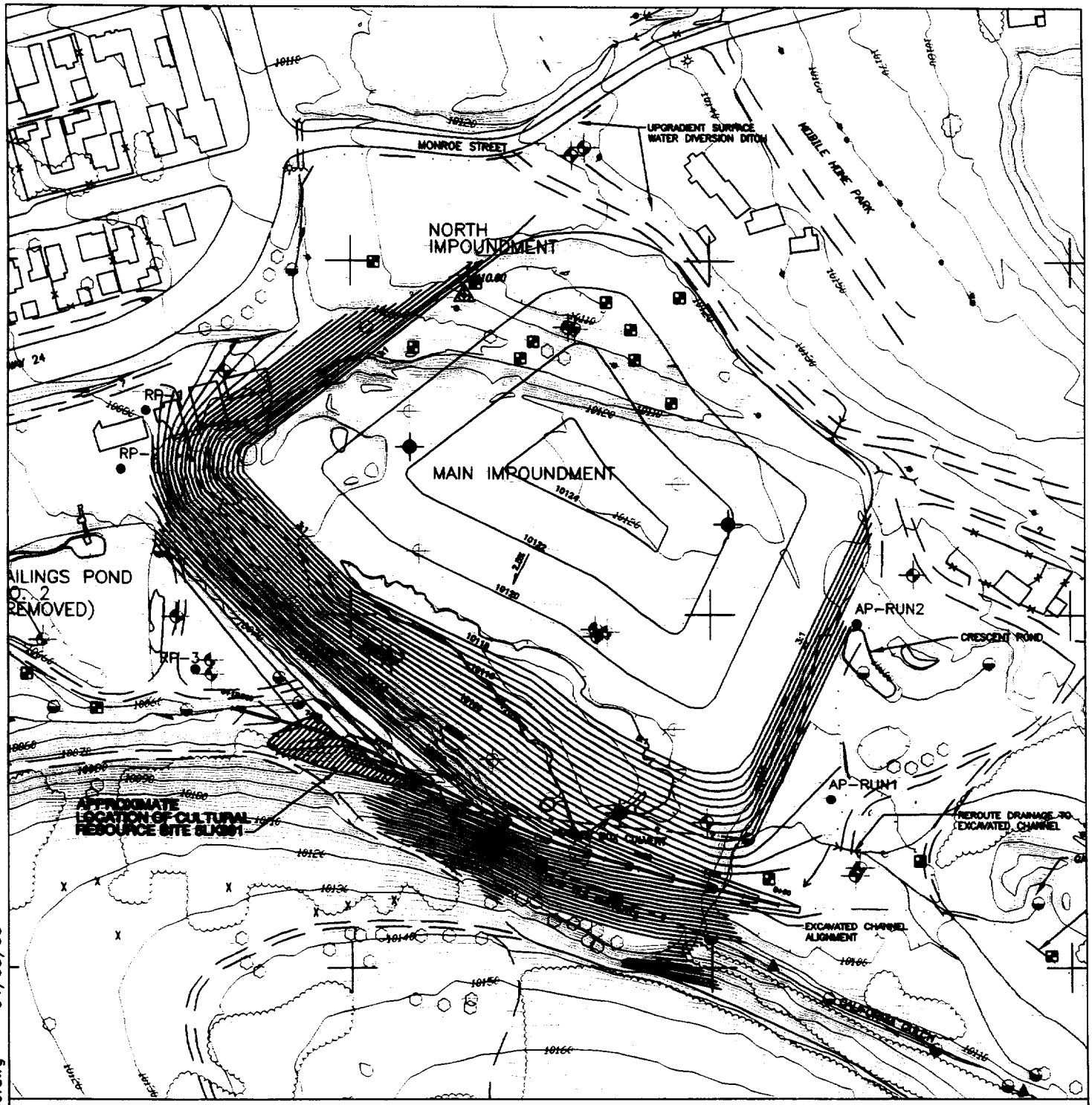
Figure 5

ALTERNATIVES 2A, 2B, 3A & 3B: REGRADING PLAN

California Gulch Superfund Site
Leadville, Colorado



SCALE

200 0 200FEET

N

LEGEND:

PAVED ROAD

GRAVEL ROAD

WATER

BUILDING/STRUCTURE

POWER POLE

SOURCE: MFG, 2000

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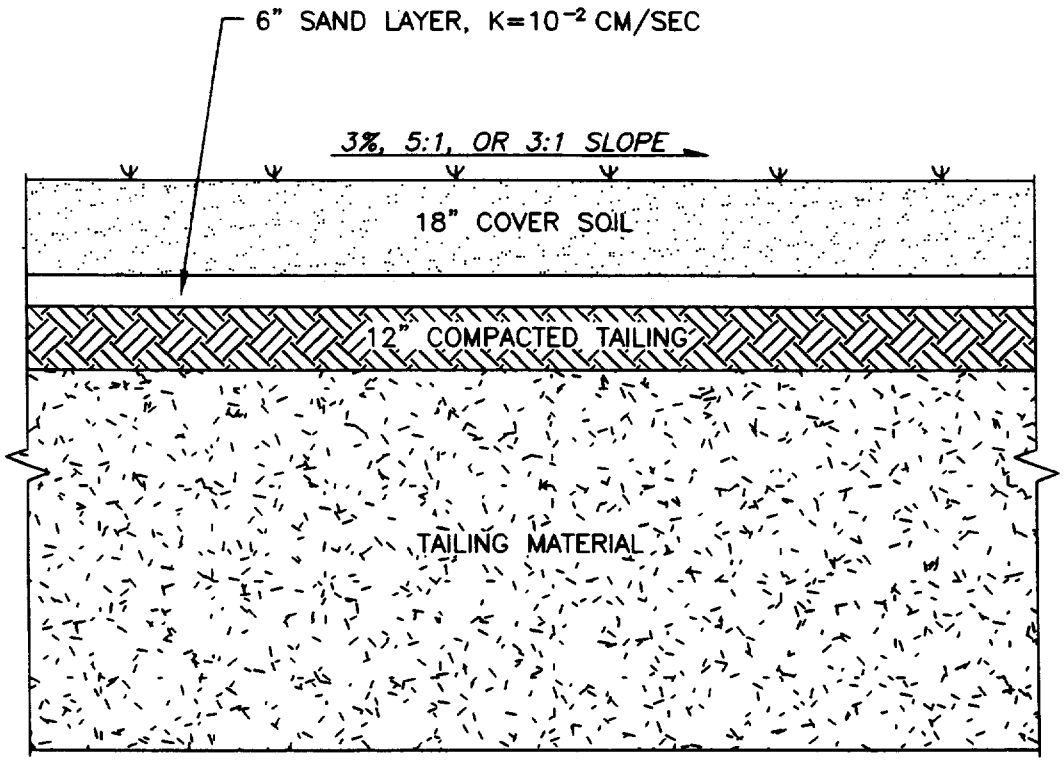
Figure 6

LOCATION OF CULTURAL RESOURCE AREA RELATIVE TO EXCAVATED CHANNEL (ALTERNATIVES 2A, 2B, 3A & 3B)

California Gulch Superfund Site
Leadville, Colorado



NOTE:

1. THIS DRAWING IS NOT TO SCALE.

SOURCE: MFG, 2000

Figure 7

ALTERNATIVE 2A, B & C:
SIMPLE SOIL COVER SECTION

California Gulch Superfund Site
Leadville, Colorado

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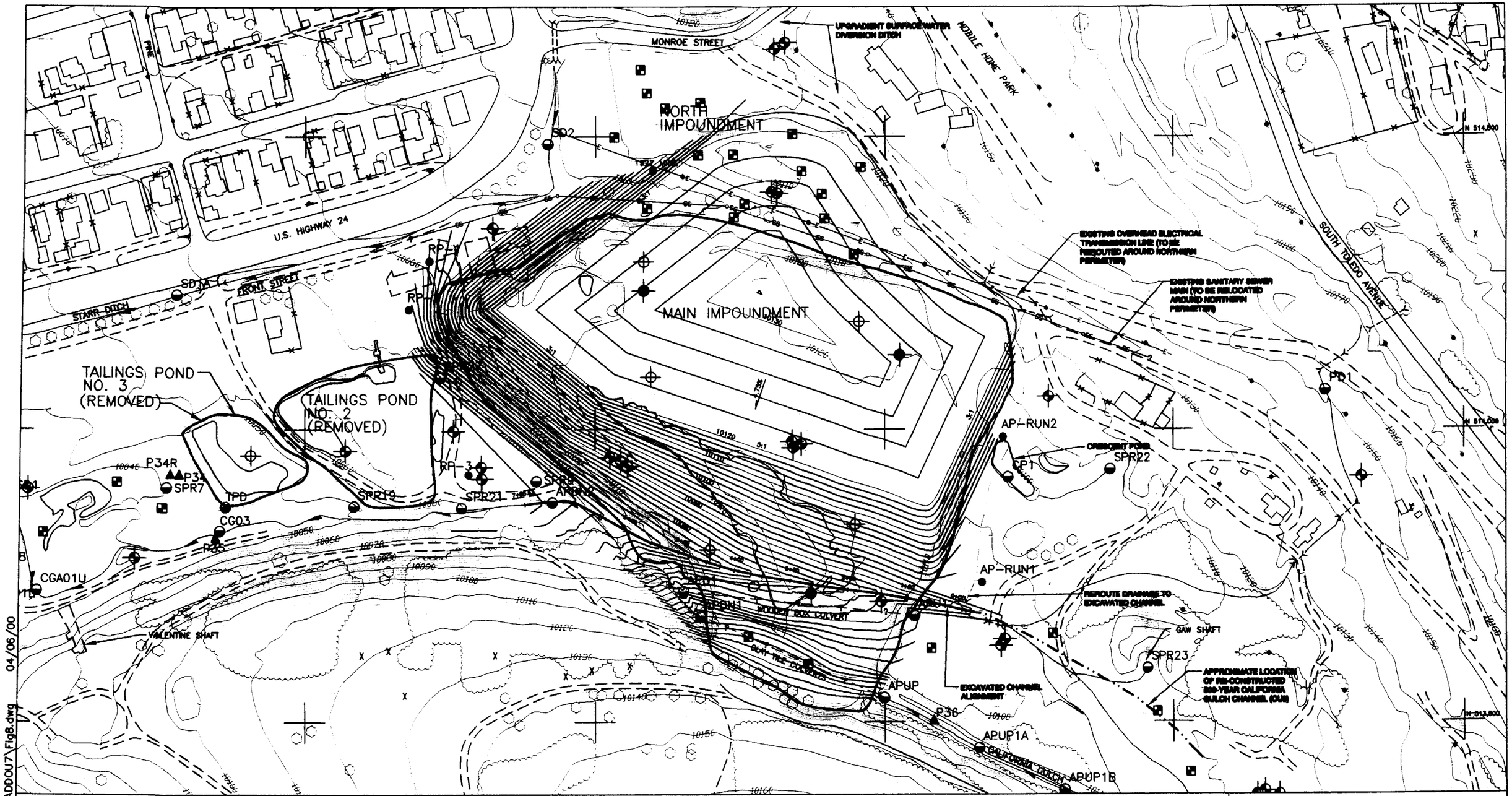

NOTE:
1. REGRADED SURFACE TOPOGRAPHY AT 2' CONTOUR INTERVALS

EXPLANATION

SURFACE WATER SAMPLE LOCATION	PAVED ROAD
GROUNDWATER MONITORING WELL	GRAVEL ROAD
SOIL BORING	WATER
MINI-PIEZOMETER	BUILDING/STRUCTURE
PIEZOMETER LOCATION	POWER POLE
SURGE POND WELL/PIEZOMETER	

N

SCALE
80 0 80 UNITS

SOURCE: MFG, 2000

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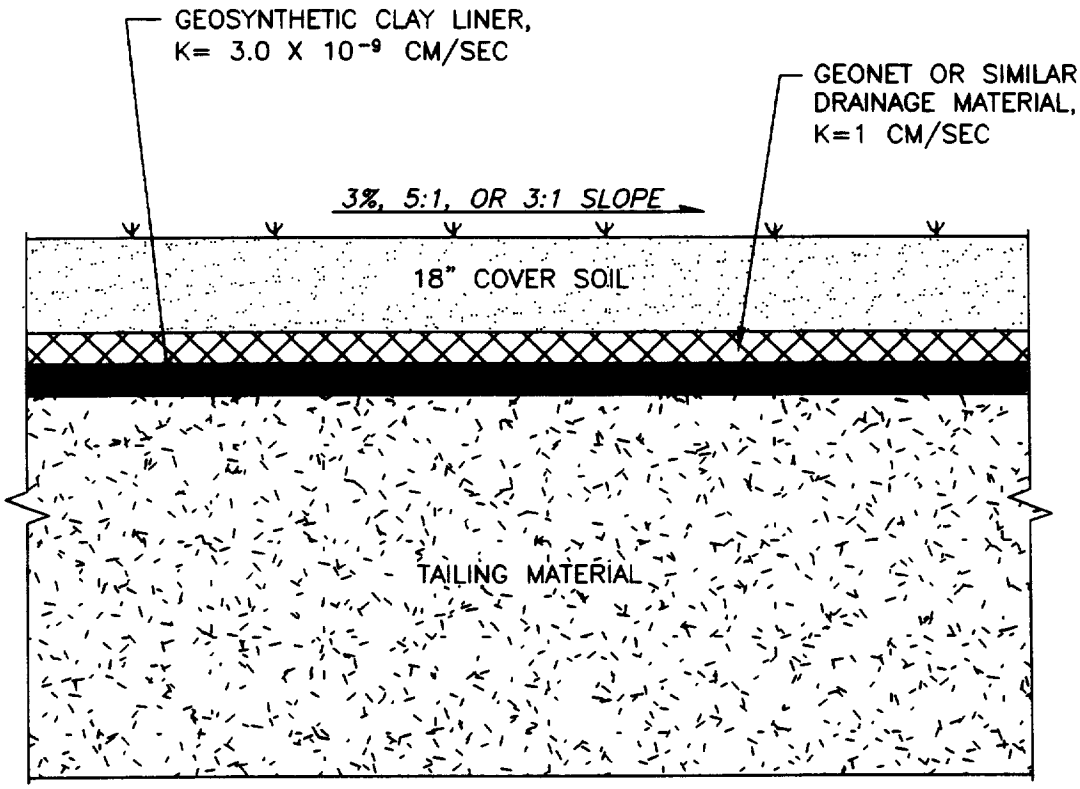
Figure 8

ALTERNATIVES 2C & 3C: REGRADING PLAN

California Gulch Superfund Site
Leadville, Colorado



NOTE:

1. THIS DRAWING IS NOT TO SCALE.

SOURCE: MFG, 2000

Figure 9

ALTERNATIVE 3A, B, & C:
MULTI-LAYER COVER SECTION

California Gulch Superfund Site
Leadville, Colorado

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N

COUNTY RD. 36

OU2-HECLA/MALTA GULCH TAILING IMPOUNDMENTS

MCWETHY DR

HIGHWAY 24

OU7-APACHE TAILING IMPOUNDMENTS

OU7-YAK TUNNEL SURGE POND

OREGON GULCH

COUNTY RD. 6

OU10-OREGON GULCH TAILING IMPOUNDMENT

APPROX. LOCATION OF ON-SITE REPOSITORY

GEORGIA GULCH

RAINES GULCH

LEGEND:

POTENTIAL TRANSPORT ROUTES

APPROXIMATE LOCATION OF MINERAL BELT BIKE TRAIL

SOURCE: MFG, 2000

SCALE

1000 0 1000 FEET

Figure 10

ALTERNATIVE 4A: POTENTIAL TRANSPORT ROUTES TO ON-SITE CONSOLIDATION SITE

California Gulch Superfund Site
Leadville, Colorado

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COUNTY RD. 36

OU2-HECLA/MALTA GULCH TAILING IMPOUNDMENTS

MCWETHY DR.

HIGHWAY 24

OU10-OREGON GULCH TAILING IMPOUNDMENT

OREGON GULCH

COUNTY RD. 6

GEORGIA GULCH

DAYMEN GULCH

OU1-CALIFORNIA TAILING IMPOUNDMENTS

OLD YAK TUNNEL SURGE POND

APPROX. LOCATION OF ON-SITE REPOSITORY

LEGEND:

POTENTIAL TRANSPORT ROUTES

APPROXIMATE LOCATION OF MINERAL BELT BIKE TRAIL

SCALE

1000 0 1000 FEET

SOURCE: MFG, 2000

Figure 11

ALTERNATIVE 4B: POTENTIAL TRANSPORT ROUTES TO ON-SITE REPOSITORY

California Gulch Superfund Site
Leadville, Colorado

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TABLES

TABLE 1
GEOTECHNICAL TEST RESULTS
OU7 - APACHE TAILING IMPOUNDMENTS

Sample Location ID	Sample Type	Material Type	Sample Depth (FT bgs)	USCS Soil Classification	Delivered Moisture (%)	Atterberg Limits			Grain Size Distribution			Specific Gravity	Natural Density		Other Tests
						LL	PL	PI	% Finer No. 34	% Finer No. 4 Sieve	% Finer No. 200 Sieve		PCF (Dry)	Moist (%)	
AP1B4	Split Spoon	Tailing	5.4'-7.0'	SM	2.8						43				
AP1B4	Split Spoon	Tailing	15.4'-17.0'	SP - SM	7						11	3.08			DS
AP1B4	Dry Core	Tailing	23.5'-24.0'	CL - ML	46	39	25	14			100	2.69			
AP1B4	Split Spoon	Tailing	31.5'-32.0'	SM	6.6						19	2.67			
AP1B5	Dry Core	Tailing	2.0'-3.0'		15.9						66	2.53			
AP1B5	Dry Core	Tailing	18.0'-19.0'		44.8						100	2.48			
AP1B6	Dry Core	Tailing	1.6'-2.6'	SM	15.9		NP				40				
AP1B6	Dry Core	Tailing	18.0'-19.0'		11.1						56				
AP1B8	Dry Core	Tailing	3.5'-4.0'		23						68	2.79			
AP1B8	Split Spoon	Tailing	15.0'-17.0'	SM	8.9						30				
AP1B8	Split Spoon	Tailing	30.0'-32.0'	CL	30.1	33	22	11			75	2.93			
MW-11S	Shelby Tube	Tailing	12'-14'		7.8								87.3	7.8	
MW-11S	Shelby Tube	Tailing	19'-20'		10.7								85.4	10.7	
MW-11S	Shelby Tube	Tailing	25'-27'		11.6				100	100	23	2.77	93.6	11.6	DS
MW-11D	Grab	Tailing	11'-12'	SM	8.1		NP		100	100	16	2.8			
MW-11D	Shelby Tube	Tailing	15'-17'		7.8		NP						92.2	7.8	
MW-11D	Grab	Tailing	23'-25'	SM	18.7		NP		100	100	41	2.8			
MW-11D	Shelby Tube	Tailing	25'-27'	SM	16.3		NP		100	100	36	2.89	95.7	16.3	DS
MW-11D	Shelby Tube	Tailing	40'-42'	CL - ML	25.3	25	19	7	100	100	71	2.85	106.2	25.3	TX, PERM
MW-11D	Grab	Tailing	45'-47'	CL	33.5	29	18	11	100	100	77	2.8			
AP1B9	Dry Core	Tailing	3.0'-4.0'		19						75				
AP1B9	Shelby Tube	Tailing	15.0'-17.5	ML	11.2	19	17	2			87	3.38	117.8	11.2	TX
AP1B9	Dry Core	Tailing	23.7'-24.0'	CL	35.8	44	24	20			100	2.83			
MW12S	Shelby Tube	Tailing	5'-7'	SM	12.9		NP		100	100	42	3.73	132.8	12.9	
MW12S	Shelby Tube	Tailing	10'-12'	SM	18.3		NP		100	100	44	2.85	111.9	18.3	
MW12S	Grab	Tailing	15'-17'	ML	23	19	18	1	100	100	86	3.71			
MW12S	Shelby Tube	Tailing	21'-22'	CL	38.5	33	22	11	100	100	98	2.88	83.8	38.5	
MW12D	Grab	Tailing	10'-11'	CL	29.4	30	21	9	100	100	72	3.88			
MW12D	Shelby Tube	Tailing	15'-17'		21								121.1	21	
MW12D	Shelby Tube	Tailing	25'-27'	ML	29.8		NP		100	100	59	2.93	106.1	29.8	PERM
MW12D	Composite	Tailing	31.6'-33'	CL	41.2	45	25	20	100	100	98	2.86			
MW12D	Composite	Alluvium	35.3'-46'	GM	11.2	28	25	3	49	36	15	2.73			
AP1B10	Dry Core	Tailing	3.0'-4.0'	SM	7.7						40				
AP1B10	Dry Core	Tailing	8.0'-9.0'	SM	2.1						18				
AP1B10	Split Spoon	Tailing	20.4'-20.8'		25.6						100	2.77			

TABLE 1 (continued)
GEOTECHNICAL TEST RESULTS
OU7 - APACHE TAILING IMPOUNDMENTS

Sample Location ID	Sample Type	Material Type	Sample Depth (FT bgs)	USCS Soil Classification	Delivered Moisture (%)	Atterberg Limits			Grain Size Distribution			Specific Gravity	Natural Density		Other Tests
						LL	PL	PI	% Finer No. 34	% Finer No. 4 Sieve	% Finer No. 200 Sieve		PCF (Dry)	Moist (%)	
AP1B10	Dry Core	Tailing	23.0'-24.0'	CL	29.5	32	23	9			99				
AP1B11	Shelby Tube	Tailing	15.0'-17.5'		42.4						100	3.42	88.6	42.4	TX, PERM
AP1B11	Shelby Tube	Tailing	20.0'-22.5'	ML	48.2	45	31	14			100	2.7	75.3	48.2	TX, PERM
MW-13D	Composite	Alluvium	18'-25'	SM	33.6		NP		64	56	13	2.92			
MW-13D	Grab	Alluvium	38'-40'	CH	39.2	64	34	30	100	100	81	2.78			
MW-16S	Grab	Alluvium	4'-7'	SM	26		NP		99	96	26				
MW-16S	Grab	Alluvium	14'-17'	GP-GC	12.5	30	22	8	41	29	8	2.72			
Proctor # 1	Bulk	Tailing	0-1'	ML	33.2		NP		100	100	66	3.18	109	23	PERM, P
Proctor # 2	Bulk	Tailing	0-1'	ML	29.8		NP		100	100	66	3.68	109.5	20	PERM, P
Proctor # 3	Bulk	Tailing	0-10'	ML	14.7	20	17	3	100	100	53	3.94	143	15	S, PERM,
TP-13	Brass Liner	Tailing	1.0'-1.5'	ML	22.7		NP		100	100	88.1		123.3	23%	PERM
TP-13	Brass Liner	Tailing	5.0'-5.5'	ML	26.6		NP		100	100	79.6		113.1	27%	PERM
TP-14	Brass Liner	Tailing	2.5'-3.0'	SM	7.1		NP		100	99.9	29.2		138.4	7%	PERM
TP-16	Brass Liner	Tailing	13'-15'	ML	19.6		NP		100	99.8	79.2		121.8	20%	PERM
AP1PZ20	Bulk	Tailing	0'-10'	ML	25.1	35	22.8	12.3	100	100	82.6				P
AP1PZ20	Split Spoon	Tailing	20'-21'	SM	20.9		NP		100	100	39.4				
AP1PZ20	Shelby Tube	Tailing	23.5'-25'	CL-ML	31.7	23.4	18.4	4.9	100	100	68.8		90.2	31.7	TX
AP1PZ21	Split Spoon	Tailing	10'-12'	SM	14.9		NP		100	100	49.3				
AP1PZ21	Split Spoon	Tailing	35'-37'	SM	19.5		NP		100	100	26.2				
AP1B22	Shelby Tube	Tailing	13'-15'	ML	39.1	26.2	23.5	2.7	100	100	89.3		86.2	39.1	DS, CON
AP1B22	Shelby Tube	Tailing	20'-22'	CL-ML	32.2	26.2	20.2	6	100	100	78.1				
AP1B22	Split Spoon	Tailing	23'-24'	ML	44.3	45.8	27.1	18.7	100	100	99.8		79.4	44.3	TX

NOTES:
CON = Consolidation
bgs = below ground surface
DS = Direct Shear
FT = Feet
LL = Liquid Limit
NP = Non Plastic
P = Proctor
PERM = Permeability
PI = Plasticity Index
PL = Plastic Limit
TX = Triaxial Test
USCS = Unified Sail Classification System

Proctor #1 is a bulk composite sample of surficial tailing from Tailing Ponds Nos. 2 and 3
Proctor #2 is a bulk composite sample of surficial tailing from the northern edge of the Main Impoundment
Proctor #3 is a bulk composite sample of the cuttings from the upper ten (10) feet of boreholes MW11S and MW11D

TABLE 2

PERMEABILITY AND COMPACTION TEST RESULTS ON TAILING SAMPLES

OU7 - APACHE TAILING IMPOUNDMENTS

ID	USCS Soil Classification	Sample Depth (FT bgs)	Sample Length (cm)	Sample Diameter (cm)	Sample Dry Density (pcf)	Proctor Test Results		Permeability Test Results				
						Maximum Dry Density (pcf)	Optimum Moisture (%)	Initial Moisture (%)	Effective Stress (psi)	Back Pressure (psi)	Gradient	Average Permeability (cm/sec)
AP1B11	--	15-17.5	15.24	6.09	88.6**	--	--	42.4	NA	NA	NA	7.00E-07
AP1B11	ML	20-22.5	9.27	6.09	75.3**	--	--	49.4	NA	NA	NA	8.10E-07
MW-11D	CL-ML	40-42	9.42	7.24	106.2**	--	--	25.3	17.4	82.6	10	2.30E-07
MW-12D	ML	25-27	9.01	7.10	106.1**	--	--	29.8	31.3	68.7	10	3.60E-07
TP-13	ML	1.0-1.5	8.23	6.12	123.3**	--	--	22.7	5.0	88.0	0.616	3.90E-06
TP-13	ML	5.0-5.5	7.27	6.18	113.1**	--	--	26.6	4.947	38.0	1.03	2.40E-06
TP-14	SM	2.5-3.0	6.40	6.12	138.4**	--	--	7.1	4.963	88.0	0.833	1.50E-03
TP-16	ML	13-15	7.55	6.18	121.8**	--	--	19.6	4.971	78.0	0.553	4.20E-05
Proctor 1	ML	0-1	9.59	7.30	97.4*	109	23	23	7	93.0	6	2.30E-06
Proctor 2	ML	0-1	9.55	7.27	99.3*	109.5	20	19.3	7	93.0	9	3.60E-07
Proctor 3	ML	0-10	9.55	7.27	129.9*	143	15	14.5	7	93.0	5	1.40E-07
AP1PZ20	ML	0-10	--	--	--	116.2	22.1	--	--	--	--	--

Notes:

cm = centimeters
cm/sec = centimeters per second
bgs = below ground surface
FT = Feet
pcf = pound per square foot
psi = pounds per square inch
USCS = Unified Soil Classification System
NA = Information not available in Tailings RI Report (WCC, 1994)

* = As recompacted for test, approximately 90% of Maximum Dry Density
** = Natural Dry Density
-- = Test not performed

TABLE 4
TAILING AND FOUNDATION SOIL GEOCHEMICAL SUMMARY
OU7 - APACHE TAILING IMPOUNDMENTS

Impoundment	Sample Location[1]	Depth Below Ground Surface	Depth Below Tailing Surface[2]	Date Corrected	Arsenic Total (mg/kg)	Arsenic SPLP (mg/L)	Arsenic SPLP/Total Ratio x 1000	Cadmium Total (mg/kg)	Cadmium SPLP (mg/L)	Cadmium SPLP/Total Ratio x 1000	Lead Total (mg/kg)	Lead SPLP (mg/L)	Lead SPLP/Total Ratio x 1000	Zinc Total (mg/kg)	Zinc SPLP (mg/L)	Zinc SPLP/Total Ratio x 1000	Total Sulfur (%)	Pyritic Sulfur (%)	Acid/Base Potential (tons/1000T)	Acid Generation Potential (tons/1000T)	Acid Neutralization Potential (tons/1000T)	ANP/AGP Ratio
WEATHERED SULFIDIC TAILING																						
Main	**AP1TMW11S**	3-4'	*same*	10/28/96	----	----	----	----	----	----	----	----	----	----	----	----	11.8	4.80	-150	150	1 U	0.007
Main	**AP1B10**	4-5'	*same*	10/22/91	376	0.010 UJ	NA	30.4	0.242	7.96	1670	0.072	0.043	5850	15.1	2.58	----	----	----	----	----	----
Main	**AP1B8**	3.5-4'	*same*	10/23/91	271 U	0.010 UJ	NA	56.8	1.79	31.5	1130 J	1.28 J	1.13	4330 J	51.3	11.8	----	----	----	----	----	----
Main	**AP1B6**	2.6-5'	*same*	10/22/91	359	0.013 J	0.036	131	7.09	54.1	730	0.427	0.585	4980	12.1	2.43	----	----	----	----	----	----
Main	**AP1T01**	0-0.15'	*same*	09/19/91	294	----	----	16.1	----	----	1090	----	----	677	----	----	----	----	----	----	----	----
Main	**AP1T02**	0-0.15'	*same*	09/19/91	257 J	----	----	9.3 J	----	----	1580	----	----	1040	----	----	----	----	----	----	----	----
Main	**AP1T03**	0-0.15'	*same*	09/19/91	343	----	----	10.4	----	----	1740	----	----	1640	----	----	----	----	----	----	----	----
TP2	**AP2B1**	4-5'	*same*	10/29/91	388	0.010 UJ	NA	39.0	0.474	12.2	1930	0.212 J	0.110	6700	28.7 J	4.28	----	----	----	----	----	----
TP3	**AP3B1**	4-5'	*same*	10/29/91	398	0.050 UJ	NA	9.8	0.448	45.7	2680	1.21 J	0.451	4030	72.3 J	17.9	----	----	----	----	----	----
North	**APNITP9**	4-5.5'	0-1.5'	08/21/97	471	0.017	0.036	38.2	0.040	1.05	5940	1.84	0.310	4640	5.87	1.27	13.31	7.48	-234	234	1 U	0.004
North	**APNITP13**	0.5-1.0'	0.5-1.0'	08/21/97	521	0.012	0.023	10.4	0.010 B	0.96	2990	2.27	0.759	1200	5.50	4.58	33.78	14.60	-454	457	3 B	0.007
North	**APNITP14**	1-1.5'	1-1.5'	08/21/97	523	0.046	0.088	16.4	0.023	1.40	4210	2.49	0.591	485	1.94	4.00	20.61	5.93	-185	185	1 U	0.005
North	**APNITP12**	4-4.5'	0-0.5'	08/21/97	277	0.003 B	0.011	11.4	0.006 B	0.53	5100	0.06 B	0.012	701	5.26	7.50	6.46	0.01 U	0	1 U	1 U	1.000
North	**APNITP10**	8-8.5'	0-0.5'	08/21/97	507	0.031	0.061	25.1	0.040	1.59	3850	3.02	0.784	2920	24.0	8.22	20.25	14.70	-455	458	3 B	0.007
North	**APNITP11**	8-8.5'	0-0.5'	08/21/97	677	0.67	0.990	24.1	0.018 B	0.75	4520	1.77	0.392	1070	5.87	5.49	18.71	9.58	-299	299	1 U	0.003
ALL WT	***Average***				395	0.0765	0.178	30.6	0.926	14.3	2797	1.33	0.470	2876	20.7	6.38	17.85	8.16	-254	255	1	0.005
	Geo-Mean				370	0.0164	0.056	22.0	0.109	4.17	2333	0.734	0.276	2051	12.2	4.96	15.99	3.00	NA	272	1	0.003
	Minimum				ND	0.003	NA	9.3	0.006	NA	730	0.06	NA	485	1.94	NA	6.46	ND	-455	ND	ND	ND
	Maximum				677	0.670	NA	131	7	NA	5940	3	NA	6700	72	NA	33.78	14.70	0	458	3	0.007
	STD				132	0.1884	NA	31	2	NA	1601	1	NA	2082	21	NA	8.06	4.92	153	154	1	0.007
Main	***Average***				317	0.0076	NA	42.3	3.04	31.2	1323	0.59	0.587	3086	26.2	5.62	NA	NA	NA	NA	NA	NA
	Geo-Mean				313	0.0068	NA	26.6	1.45	23.9	1267	0.34	0.305	2294	21.1	4.20	NA	NA	NA	NA	NA	NA
	Minimum				ND	ND	NA	9.3	0.2	NA	730	0.07	NA	677	12.10	NA	NA	NA	NA	NA	NA	NA
	Maximum				376	0.0128	NA	131	7.09	NA	1740	1.28	NA	5850	51.3	NA	NA	NA	NA	NA	NA	NA
	STD				81.487	0.0037	NA	42.8	2.9	NA	366	0.5	NA	2035	17.8	NA	NA	NA	NA	NA	NA	NA
North	***Average***				496	0.130	0.201	20.9	0.023	1.05	4435	1.91	0.475	1836	8.07	5.18	18.85	8.72	-271	272	1	0.005
	Geo-Mean				480	0.0289	0.060	18.9	0.018	0.98	4335	1.22	0.282	1345	5.99	4.46	16.82	2.77	NA	307	1	0.003
	Minimum				277	0.003	NA	10.4	0.006	NA	2990	0.06	NA	485	1.94	NA	6.46	ND	-455	ND	ND	ND
	Maximum				677	0.670	NA	38.2	0.04	NA	5940	3.02	NA	4640	24	NA	33.78	14.70	0	458	3	0.007
	STD				117.49	0.242	NA	9.6	0.0133	NA	931	0.93	NA	1480	7.25	NA	8.29	5.10	158	159	1	0.006
GRAY SULFIDIC TAILING																						
Main	**AP1B4**	3.7-5'	*same*	10/24/91	339 J	0.010 UJ	NA	34.1 J	1.02	29.9	664 J	0.128 J	0.193	2720 J	33.8	12.43	----	----	----	----	----	----
Main	**AP1B4**	9-10'	*same*	10/24/91	729	0.010 U	NA	90.1	0.251	2.79	2180	2.2 J	1.01	16000	11.7 J	0.73	----	----	----	----	----	----
Main	**AP1B4**	14-15'	*same*	10/24/91	217	0.010	0.046	94.5 J	0.769 J	8.14	2120 J	2.39 J	1.13	15200 J	75.2	4.95	----	----	----	----	----	----
Main	**AP1B8**	9-10'	*same*	10/23/91	218 U	0.010 UJ	NA	29.9	0.128	4.28	1110 J	1.06 J	0.955	5210 J	5.19	1.00	----	----	----	----	----	----
Main	**AP1B8**	5-7'	*same*	10/23/91	160 J	0.010 U	NA	29.4	0.005 U	NA	1060	0.005 J	0.005	4820	0.2 J	0.04	----	----	----	----	----	----
Main	**AP1B9**	14-15'	*same*	10/21/91	697 J	0.010 UJ	NA	80.0	0.017	0.21	3420	0.051	0.015	14100	0.569	0.04	----	----	----	----	----	----
Main	**AP1B6**	16-17'	*same*	10/22/91	242 J	0.010 UJ	NA	35.2 J	0.088	2.49	2080	0.016 J	0.008	10800	4.64 J	0.43	----	----	----	----	----	----
Main	**AP1B5**	4-5'	*same*	10/23/91	164	0.010 U	NA	21.6 J	0.134 J	6.20	541 J	0.033 J	0.061	4250 J	1.16	0.27	----	----	----	----	----	----
Main	**AP1TMW11S**	8-10'	*same*	10/28/96	----	----	----	----	----	----	----	----	----	----	----	----	17.40	7.30	-163	228	65	0.285
Main	**AP1TMW11S**	4-5'	*same*	10/28/96	----	----	----	----	----	----	----	----	----	----	----	----	13.60	6.73	-164	210	46	0.219
TP2	**AP2B1**	8.8-9.8'	*same*	10/29/91	102	0.010 UJ	NA	113	0.005 UJ	NA	7410	0.031 J	0.004	15400	1.64 J	0.11	----	----	----	----	----	----
North	**AP1TMW14S**	15-16'	9.3-10.3'	11/12/96	304	0.003 B	0.010	104	0.047	0.45	2830	2.38	0.841	17300	64.7	3.74	19.70	3.66	-40	114	74	0.649
North	**APNITP11**	10-10.5'	2-2.5'	08/21/97	300 B	0.002 B	0.007	181	0.071	0.39	9300	1.90	0.204	36600	81.9	2.24	25.93	13.00	-375	406	31	0.076
North	**AP1TMW14D**	15-16'	9.5-10.5'	11/08/96	690	0.001 B	0.001	143	0.043	0.30	4230	1.35	0.319	21700	66.5	3.06	18.10	5.70	-142	178	36	0.202
North	**AP1TMW14D**	16-17'	10.5-11.5'	11/08/96	134	0.001 U	NA	34.3	0.071	2.07	3910	1.24	0.317	5220	32.0	6.13	20.50	6.93	-150	217	67	0.309
North	**APNITP10**	12.5'	4.5'	08/21/97	800 B	0.001 U	NA	355	0.284	0.80	7240	1.00	0.138	59700	66.5	1.11	20.50	11.30	-318	353	35	0.099
North	**APNITP13**	5-7'	5-7'	08/21/97	240	0.007	0.029	118	0.314	2.66	12500	2.88	0.230	19300	67.4	3.49	22.23	11.40	-319	356	37	0.104
North	**APNITP12**	12.12.5'	8-8.5'	08/21/97	410	0.003 B	0.007	203	0.597	2.94	18500	3.34	0.181	30100	40.8	1.36	17.40	13.60	-387	425	38	0.089
North	**APNITP14**	5'	5'	08/21/97	970	0.003 B	0.003	154	0.273	1.77	3010	2.94	0.977	20900	67.6	3.23	31.28	9.68	-273	303	30	0.099
ALL GT	*Average*				389	0.003	0.015	107	0.184	4.36	4830	1.71	0.387	17607	49.0	2.61	20.66	8.93	-233	279	46	0.165
	Geo-Mean				304.88	0.0032	0.008	79.7	0.096	1.87	3100	0.431	0.139	12996	13.7	1.06	20.17	8.31	NA	260	44	0.168
	Minimum				102	0.0005	NA	21.6	ND	NA	541	0.005	NA	2720	0.20	NA	13.60	3.66	-387	114	30	0.263
	Maximum				970	0.01	NA	355	1.02	NA	18500	3.3	NA	59700	81.9	NA	31.28	13.60	-40	425	74	0.174
	STD				368.75	0.0023	NA	82.6	0.2836	NA	4693	1.1	NA	13852	30.5	NA	4.71	3.17	111	99.0	16	0.158
Main	*Average*				332	0.0056	NA	51.9	0.301	7.72	1647	0.735	0.422	9138	16.6	2.49	15.50	7.02	-164	219	56	0.253
	Geo-Mean				267	0.0055	NA	44.6	0.103	3.70	1390	0.132	0.095	7567	4.187	0.553	15.38	7.01	NA	219	55	0.250
	Minimum				ND	ND	NA	21.6	ND	NA	541	0.005	NA	2720	0.200	NA	13.60	6.73	-164	210	46	0.219
	Maximum				729	0.01	NA	95	1.02	NA	3420	2.39	NA	16000	75.2	NA	17.40	7.30	-163	228	65	0.285
	STD				229	0.0017	NA	29	0.3556	NA	913	0.95987	NA	5128	24.5	NA	1.90	0.28	1	9	10	1.056
North	*Average*				481	0.0025	0.010	162	0.213	1.42	7690	2.13	0.401	26353	60.93	3.05	21.96	9.41	-251	294	44	0.148
	Geo-Mean				399	0.0018	0.006	137	0.140	1.03	6204	1.96	0.315	21852	58.62	2.68	21.58	8.67	NA	271	41	0.152
	Minimum				134	ND	NA	34.3	ND	NA	2830	1	NA	5220	32	NA	17.40	3.66	-387	114	30	0.263
	Maximum				970	0.007	NA	355	0.597	NA	18500	3.34	NA	59700	81.9	NA	31.28	13.60	-40	425	74	0.174
	STD				281.11	0.002	NA	87.6	0.1813	NA	5179	0.83	NA	15251	15.18	NA	4.30	3.37	117.3	105	16	0.151

TABLE 4 (continued)
TAILING AND FOUNDATION SOIL GEOCHEMICAL SUMMARY
OU7 - APACHE TAILING IMPOUNDMENTS

Impoundment	Sample Location[1]	Depth Below Ground Surface	Depth Below Tailing Surface[2]	Date Corrected	Arsenic Total (mg/kg)	Arsenic SPLP (mg/L)	Arsenic SPLP/Total Ratio x 1000	Cadmium Total (mg/kg)	Cadmium SPLP (mg/L)	Cadmium SPLP/Total Ratio x 1000	Lead Total (mg/kg)	Lead SPLP (mg/L)	Lead SPLP/Total Ratio x 1000	Zinc Total (mg/kg)	Zinc SPLP (mg/L)	Zinc SPLP/Total Ratio x 1000	Total Sulfur (%)	Pyritic Sulfur (%)	Acid/Base Potential (tons/1000T)	Acid Generation Potential (tons/1000T)	Acid Neutralization Potential (tons/1000T)	ANP/AGP Ratio
BROWN OXIDE TAILING																						
Main	**AP1B9**	18.5-19.5'	*same*	10/21/91	77.0	0.010 UJ	NA	12.1	0.006	0.51	4590	0.003 UJ	NA	2630	0.090	0.03	----	----	----	----	----	----
Main	**AP1B8**	14-15'	*same*	10/23/91	115 U	0.010 UJ	NA	14.5	0.097	6.67	1940 J	0.026	0.014	2140 J	1.55	0.72	----	----	----	----	----	----
Main	**AP1B8**	19-20'	*same*	10/23/91	73.2	0.010 UJ	NA	28.3	0.134	4.73	1800 J	0.012	0.007	7050 J	4.99	0.71	----	----	----	----	----	----
Main	**AP1B10**	12.4-14'	*same*	10/22/91	46.2 J	0.010 UJ	NA	23.2 J	0.031	1.34	1260	0.014 J	0.011	3980 J	1.37 J	0.34	----	----	----	----	----	----
Main	**AP1B6**	31-32'	*same*	10/22/91	89.0	0.010 UJ	NA	19.1	0.665	34.8	4090	0.085	0.021	4070	12.3	3.02	----	----	----	----	----	----
Main	**AP1B9**	31-32'	*same*	10/21/91	154 J	0.010 UJ	NA	12.0 J	0.020	1.63	8390	0.008 J	0.001	2890 J	0.465 J	0.16	----	----	----	----	----	----
Main	**AP1B8**	39-40'	*same*	10/23/91	63.1 U	0.010 UJ	NA	36.3	0.005 U	NA	2580 J	0.003 U	NA	6110 J	0.023	0.004	----	----	----	----	----	----
Main	**AP1B8**	44-45	*same*	10/23/91	91.8 J	0.010 U	NA	34.2	0.005 U	NA	3390	0.005 J	0.002	6840	0.189 J	0.03	----	----	----	----	----	----
Main	**AP1B8**	46.7-47'	*same*	10/23/91	55.8 U	0.010 UJ	NA	88.9	0.012	0.13	2430 J	0.021	0.009	6990 J	0.144	0.02	----	----	----	----	----	----
Main	**AP1B8**	24-25'	*same*	10/23/91	53.7 U	0.010 UJ	NA	10.1	0.016	1.55	1780 J	0.004	0.002	2257 J	0.217	0.10	----	----	----	----	----	----
Main	**AP1B8**	29-30'	*same*	10/23/91	107 J	0.010 U	NA	27.3	0.012	0.45	4320	0.003 J	0.001	5410	0.401 J	0.07	----	----	----	----	----	----
Main	**AP1B8**	34-35'	*same*	10/23/91	91.1 U	0.010 UJ	NA	7.0	0.005 U	NA	3420 J	0.004	0.001	1930 J	0.02 U	NA	----	----	----	----	----	----
Main	**AP1B10**	19-20'	*same*	10/22/91	33.6	0.010 UJ	NA	5.4	0.018	3.39	1050	0.003 UJ	NA	1630	3.04	1.87	----	----	----	----	----	----
Main	**AP1TMW12S**	26.7-28.2	*same*	10/31/96	----	----	----	----	----	----	----	----	----	----	----	----	1.28	0.59	266	18	244	13.556
Main	**AP1TMW11D**	42-44'	*same*	10/25/96	----	----	----	----	----	----	----	----	----	----	----	----	0.84	0.27	151	8	159	19.875
Main	**AP1TMW11S**	37-39'	*same*	10/28/96	----	----	----	----	----	----	----	----	----	----	----	----	0.35	0.05 B	85	2	87 B	43.500
Main	**AP1TMW11D**	32-34'	*same*	10/25/96	----	----	----	----	----	----	----	----	----	----	----	----	0.26	0.02 B	73	1	74	74.000
Main	**AP1TMW11D**	17-19'	*same*	10/24/96	----	----	----	----	----	----	----	----	----	----	----	----	1.61	0.53	-15	17	2 B	0.118
Main	**AP1TMW12S**	31.5-32.0'	*same*	10/31/96	----	----	----	----	----	----	----	----	----	----	----	----	1.46	0.70	-8	22	14	0.636
Main	**AP1B4**	19-20'	*same*	10/24/91	52.5	0.010 U	NA	4.5	0.098 J	21.7	1280 J	0.006 J	0.004	1150 J	3.66	3.18	----	----	----	----	----	----
Main	**AP1B10**	24-25'	*same*	10/22/91	143	0.010 UJ	NA	33.9	0.073	2.15	7740	0.003 UJ	NA	13000	2.83	0.22	----	----	----	----	----	----
Main	**AP1B5**	19-20'	*same*	10/23/91	175	0.010 U	NA	64.1 J	0.0221 J	0.34	4030 J	0.026 J	0.006	17600 J	0.486	0.03	----	----	----	----	----	----
Main	**AP1B5**	35.5-37'	*same*	10/23/91	84.9	0.010 U	NA	35.4	0.005 U	NA	3890	0.003 UJ	NA	8100	0.191 J	0.02	----	----	----	----	----	----
North	**AP1TMW14S**	16-16.4'	10.3-10.7'	11/12/96	----	----	----	----	----	----	----	----	----	----	----	----	4.03	0.34	5	11	16	1.455
Main	***Average***				77.444	ND	NA	26.8	0.0714	4.97	3411	0.013	0.007	5516	1.88	0.658	0.97	0.36	92	11.3	97	8.529
	Geo-Mean				65.8	ND	NA	19.7	0.0195	1.96	2876	0.00594	0.004	4230	0.503	0.145	0.78	0.20	NA	7	80	11.543
	Minimum				26.85	ND	NA	4.5	ND	NA	1050	ND	NA	1150	ND	NA	0.26	0.02	-15	1	2	2.000
	Maximum				175	ND	NA	88.9	0.665	NA	8390	0.0854	NA	17600	12.3	NA	1.61	0.70	266	22	244	11.091
	STD				44.071	0	NA	21.4	0.1535	NA	2038	0.01989	NA	4229	3.0	NA	0.5	0.26	96	8.1	84	10.307
FOUNDATION SOILS																						
Main	**AP1B8**	59-61'	12-14'	10/23/91	25.9	0.010 UJ	NA	5.0	0.005 U	NA	374 J	0.003 U	NA	737 J	0.033	0.04	----	----	----	----	----	----
Main	**AP1B9**	32-34'	0-2'	10/21/91	134 J	0.010 UJ	NA	22.6	0.014	0.61	3080	0.003 UJ	NA	3940	0.091	0.02	----	----	----	----	----	----
Main	**AP1TMW12D**	33.6-34.0'	0-0.4'	10/29/96	139	0.001 B	0.007	67.8	0.102	1.50	7020	0.040 U	NA	9040	13.4	1.48	0.65	0.22	23	30	7	0.233
Main	**AP1B8**	54-56'	7-9'	10/23/91	4.1	0.010 UJ	NA	0.59 U	0.005 U	NA	8.4 J	0.003 U	NA	22.9 J	0.101	4.41	----	----	----	----	----	----
Main	**AP1B6**	41-42'	1-2'	10/22/91	45	0.010 UJ	NA	8.5	0.005	0.59	1736	0.003 U	NA	2915	0.039	0.01	----	----	----	----	----	----
Main	**AP1B5**	40.3-42'	0-1.7'	10/23/91	206	0.010 U	NA	417 J	0.226 J	0.54	13700 J	0.296 J	0.022	52400 J	5.77	0.11	----	----	----	----	----	----
Main	**AP1B8**	49-50'	2-3'	10/23/91	11.5	0.010 UJ	NA	4.8	0.005 U	NA	526 J	0.043	0.081	706 J	0.113	0.16	----	----	----	----	----	----
Outside[3]	**AP1B3**	4.8-6'	*same*	09/17/91	45.7	0.010 U	NA	3.5	0.005 UJ	NA	3840 J	0.028	0.007	1450	0.097 J	0.07	----	----	----	----	----	----
Outside	**AP1B2**	5-7'	*same*	09/17/91	150	0.010 U	NA	72.5 J	0.050	0.69	2210	0.003 UJ	NA	6340	1.57	0.25	----	----	----	----	----	----
Outside	**AP1B1**	11-12'	*same*	09/24/91	23.9 J	0.010 U	NA	0.59 U	0.005 U	NA	365	0.003 UJ	NA	660 J	0.027 J	0.04	----	----	----	----	----	----
Outside	**AP1B1**	16-17'	*same*	09/24/91	16 J	0.010 U	NA	5.9	0.005 U	NA	437	0.0035 J	0.008	858 J	0.100 J	0.12	----	----	----	----	----	----
TP2	**AP2B1**	11-12'	2-3'	10/29/91	50.7	----	----	2.8 U	----	----	2060	----	----	992	----	----	----	----	----	----	----	----
TP3	**AP3B1**	5-7'	0-2'	10/29/91	26.5	0.010 UJ	NA	5.2	0.005 U	NA	694	0.003 UJ	NA	1600	0.066 J	0.04	----	----	----	----	----	----
North	**AP1TMW14D**	19-20'	2.4-3.4'	11/08/96	59	0.001 B	0.017	4.8	0.069	14.4	71	0.040 U	NA	239	6.97	29.16	0.48	0.01 U	0	1 U	1 U	1.000
North	**AP1TMW14S**	18-19'	1.6-2.6'	11/12/96	----	----	----	----	----	----	----	----	----	----	----	----	1.16	0.14	-4	4	1 U	0.250
ALL FS	***Average***				67.0	NA	NA	44.3	0.037	3.05	2580	0.032	0.030	5850	2.18	2.76	0.76	0.12	6.3	11	2.7	0.235
	Geo-Mean				41.4	NA	NA	6.93	0.009	1.19	858	0.006	0.018	1414	0.254	0.175	0.71	0.05	NA	NA	NA	NA
	Minimum				4.1	0.001	NA	ND	ND	NA	8.4	ND	NA	22.9	0.03	NA	0.48	ND	-4	ND	ND	NA
	Maximum				206	ND	NA	417	0.226	NA	13700	0.04	NA	52400	13.4	NA	1.16	0.22	23	30	7	0.233
	STD				60.93	0.0014	NA	105.915	0.0627	NA	3599	0.08	NA	13148.9	3.9	NA	0.29	0.09	11.9	13.2	3.1	0.233

Notes:

Acid-Base Potential = Acid Neutralization Potential (ANP) - Acid Generation Potential (AGP)
ANP/AGP Ration = Acid Neutralization Potential/Acid Generation Potential
Total Sulfur = organic sulfur + pyritic sulfur + sulfate sulfur
One-half of the detection limit is used to replace undetected values for the calculation of the summary statistics.

[1] = AP1B1, AP1B2 and AP1B3 are located west of Tailings Pond No. 3 and correspond to wells AP1TMW2, AP1TMW3, respectively.
AP1B8, AP1B9 and AP1B10 corresponds to wells AP1TMW8, AP1TMW9 and AP1TMW10 are located on the Main Impoundment, respectively.

[2] = Depth below tailing surface differs from the ground surface where the upper surface of the North Impoundment tailing is covered by several feet of fill, and where foundation soils lie below the tailing.

[3] = Locations AP1B1, AP1B2 and AP1B3 are located downgradient and outside of the tailing impoundments boundaries but are included because they contain comparable soils.

---- = Sample not analyzed for this parameter.

B = Analyte concentration was detected at a value between the method detection limit and the practical quantitation limit.
J = Estimated value
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
NA = Calculation not possible or appropriate due to nondetected value or negative value
SPLP = Synthetic Precipitation Leach Procedure
U = Analyte was not detected at the method detection limit

TABLE 5
MAIN IMPOUNDMENT SURFACE COMPOSITE SAMPLING RESULTS
OU7 - APACHE TAILING IMPOUNDMENTS

Sample Number	L-AP1501-01-91091		L-AP1T02-01-91091		L-AP1T03-01-910919	
Depth Interval	9 0-0.15'		9 0-0.15'		0-0.15'	
Date Collected	09/19/91		09/19/91		09/19/91	
Sample Type	STC		STC		STC	
Antimony	35.6	U	69.5	U	32.1	U
Arsenic	294		257	J	343	
Barium	119	UJ	232	UJ	107	UJ
Beryllium	8.1		5.8	U	2.7	U
Cadmium	16.1		9.3	J	10.4	
Chromium	19.9		11.6	U	5.3	U
Copper	90.2		83.9		376	
Lead	1,090		1,580		1,740	
Manganese	273		380		701	
Mercury	0.11		0.17		0.37	
Nickel	24.5		46.3	U	21.4	U
Silver	27.7		24.8		30.5	
Thallium	1.1	UJ	1.2	UJ	1.2	J
Zinc	677		1,040		1,640	

Notes:

All Units in mg/kg

STC = Surface tailing composite

U = not detected

J = estimated quantity

TABLE 6

TAILING IMPOUNDMENT SUBSURFACE SAMPLING RESULTS - TOTAL METALS

OU7 - APACHE TAILING IMPOUNDMENTS

Sample Number	**1-AP1B202S-01-910917**	**L-AP1B404T-01-911024**	**L-AP1B514S-01-911023**	**L-AP1B607T-01-911023**	**L-AP1B803T-01-911023**	**L-AP1B809S-01-911023**	**L-AP1B8135S-01-911023**
Impoundment Number	**Main Impoundment**	**Main Impoundment**	**Main Impoundment**	**Main Impoundment**	**Main Impoundment**	**Main Impoundment**	**Main Impoundment**
Test Hole Number	**AP1B2**	**AP1B4**	**AP1B5**	**AP1B6**	**AP1B8**	**AP1B8**	**AP1B8**
Depth Interval	**5-7'**	**9-10'**	**35.5-37'**	**16-17'**	**5-7'**	**29-30'**	**44-45'**
Date Collected	**09/17/91**	**10/24/91**	**10/23/91**	**10/22/91**	**10/23/91**	**10/23/91**	**10/23/91**
Sample Type	**FS**	**T**	**T**	**T**	**T**	**T**	**T**
Antimony	R	130 U	33.7 U	12.8 UJ	7 U	32.5 U	38 U
Arsenic	150	729	84.9	242 J	160 J	107 J	91.8 J
Barium	81 J	R	R	2.9 J	R	R	R
Beryllium	3.1 U	10.8 U	2.8 U	1.1 U	0.6 U	2.7 U	3.2 U
Cadmium	72.5 J	90.1	35.4	65.2 J	29.4	27.3	34.2
Chromium	6.3 U	21.6 U	12	2.1 U	2.2	10.6	6.3 U
Copper	389	611	1910	509	213	1250	1430
Lead	2210	2180	3890	2080	1060	4320	3390
Manganese	2700	5720	3990	5750	2140	3550	3750
Mercury	0.56	0.16	1.4 J	0.21	0.12 J	1.4 J	1.1 J
Nickel	25.1 U	86.4 U	22.4 U	11.1	11.8	21.7 U	25.3 U
Silver	R	34.3	5.6 U	R	30.4	18.3	25.8
Thallium	6.3 UJ	1.1 U	11.2 UJ	2	1.1 U	5.4 U	1.3 U
Zinc	6340	16,000	8,100	10,800	4,820	5,410	6,840
Sample Number	**L-AP1B910S-01-911021**	**L-AP1B1005S-01-911022**	**L-AP2B102T-01-911029**	**L-AP21B103T-01-911029**	**L-AP2B104S-01-911029**	**L-AP3B102T-01-911029**	**L-AP3B103S-01-911029**
Impoundment Number	**Main Impoundment**	**Main Impoundment**	**Tailing Pond No. 2**	**Tailing Pond No. 2**	**Tailing Pond No. 2**	**Tailing Pond No. 3**	**Tailing Pond No. 3**
Test Hole Number	**AP1B9**	**AP1B10**	**AP2B1**	**AP2B1**	**AP2B1**	**AP3B1**	**AP3B1**
Depth Interval	**31-32'**	**12.4-14'**	**4-5'**	**8.8-9.8'**	**11-12'**	**4-5'**	**5-7'**
Date Collected	**10/21/91**	**10/22/91**	**10/29/91**	**10/19/91**	**10/29/91**	**10/29/91**	**10/29/91**
Sample Type	**T**	**T**	**T**	**T**	**FS**	**T**	**FS**
Antimony	41.3 UJ	21.5 UJ	74.5 U	15 U	33.4 U	80.7 U	14 U
Arsenic	154 J	46.2 J	388	102	50.7	398	26.5
Barium	395 J	25.4 J	41.3 J	2690 J	451 J	121 J	100 J
Beryllium	6.9 U	1.8 U	6.2 U	1.2 U	2.8 U	6.7 U	1.2 U
Cadmium	12 J	23.2 J	39	113	2.8 U	9.8	5.2
Chromium	10.4	3.6 U	12.4 U	7.5	5.6 U	13.5 U	4.2 J
Copper	1640	1360	308	970	82.7	353	167
Lead	8390	1260	1930	7410	2060	2680	694
Manganese	1110	1140	5250	2300	1840	1600	517
Mercury	2.8	0.78	0.31 J	2.6 J	0.72 J	0.4 J	0.58 J
Nickel	27.5 U	14.4 U	49.7 U	10.5	22.2 U	53.8 U	9.3 U
Silver	R	R	R	R	R	R	R
Thallium	1.4 UJ	1.2 UJ	1.2 U	1.3 U	1.1 U	1.3 U	1.2 UJ
Zinc	2890 J	3,980 J	6,700	15,400	992	4,030	1,600

Notes:
All Units in mg/kg
T = Tailing subsurface sample
FS = Foundation soil sample
NR = not analyzed
U = not detected
J = estimated quantity
R = data rejected

TABLE 7
IMPOUNDMENT POND WATER AND RUNOFF SAMPLE RESULTS
OU7 - APACHE TAILING IMPOUNDMENTS

SAMPLE LOCATION	MAIN IMPOUNDMENT	MAIN IMPOUNDMENT	MAIN IMPOUNDMENT	TAILING POND 3	TAILING POND 2
LAB NUMBER	NA	L13670-06	L15735-01	L14201-17	L14201-16
SAMPLE NUMBER	L-APPDW-01-910917	Apache RAW	MIRO-1	M-TP3-01-6997	M-TP2-01-6997
SAMPLE DATE	09/17/91	05/06/97	09/20/97	06/09/97	06/09/97
SAMPLE TYPE	Pond Water	Pond Water	Surface Runoff	Pond Water	Pond Water
Field Parameters					
pH (units)	NR	NR	2	2.07	2.43
Conductivity @ 25C (umhos/cm)	1.7	NR	23100	6130	5870
Major Constituent and Inorganics					
Bicarbonate (mg/L)	NR	NR	2 U	2 U	2 U
Carbonate (mg/L)	NR	NR	2 U	2 U	2 U
Calcium (mg/L)	NR	NR	650	416	363 B
Chloride (mg/L)	NR	NR	23	14.3	16.4
Fluoride (mg/L)	NR	NR	0.1 U	0.1 U	0.1 U
Magnesium (mg/L)	NR	8950	960	440	366
Nitrite as N (mg/L)	NR	NR	60	0.01 U	0.1 U
Nitrate as N (mg/L)	NR	NR	34	0.9 B	0.7 B
Nitrate/Nitrite as N (mg/L)	NR	NR	100	0.9 B	0.7 B
Potassium (mg/L)	NR	NR	30 U	4 B	4 B
Sodium (mg/L)	NR	NR	30 U	14	12
Sulfate (mg/L)	NR	NR	45300	7340	5700
Phosphorus, dissolved (mg/L)	NR	NR	NR	0.053	0.137
Phosphors, ortho dissolved (mg/L)	NR	NR	NR	0.07 B	0.05 B
Metals, Dissolved					
Aluminum (mg/L)	495	NR	NR	NR	NR
Antimony (mg/L)	0.0122	NR	NR	NR	NR
Arsenic (mg/L)	541	NR	55	0.005 B	0.036
Barium (mg/L)	2 U	NR	NR	NR	NR
Cadmium (mg/L)	2.17	NR	15.8	0.41	0.8
Chromium (mg/L)	2 U	NR	NR	NR	NR
Copper (mg/L)	25	NR	130	0.85	1.79
Iron (mg/L)	27800	NR	27300	951	1360
Lead (mg/L)	R	NR	0.05 U	0.171	0.263
Manganese (mg/L)	144	NR	765	355	335
Mercury (mg/L)	0.0002 U	NR	NR	NR	NR
Nickel (mg/L)	4 U	NR	NR	NR	NR
Selenium (mg/L)	0.1 UJ	NR	NR	NR	NR
Silver (mg/L)	0.0018	NR	NR	NR	NR
Zinc (mg/L)	361	NR	1840	246	269
Metals, Total					
Aluminum (mg/L)	497	NR	NR	NR	NR
Antimony (mg/L)	0.01 B	NR	NR	NR	NR
Arsenic (mg/L)	53.9	0.716	NR	0.005 U	0.04 B
Barium (mg/L)	5.5 U	NR	NR	NR	NR
Cadmium (mg/L)	2.11	0.248	NR	0.369	0.75
Chromium (mg/L)	5.5 U	0.022	NR	NR	NR
Copper (mg/L)	32	2.11	NR	0.9	1.7
Iron (mg/L)	27800	943	NR	987	1420
Lead (mg/L)	0.56 J	0.096	NR	0.171	0.282
Manganese (mg/L)	140	NR	NR	358	337
Mercury (mg/L)	0.00022	0.0002 U	NR	NR	NR
Nickel (mg/L)	11 U	NR	NR	NR	NR
Selenium (mg/L)	R	0.004 J	NR	NR	NR
Silver (mg/L)	0.0126	0.0003 J	NR	NR	NR
Zinc (mg/L)	355	21.9	NR	254	268
Other Water Quality Parameters					
Total Alkalinity as CaCO3 (mg/L)	NR	NR	2 U	2 U	2 U
Dissolved Organic Carbon (mg/L)	NR	NR	NR	3 B	3 B
Hardness as CaCO3 (mg/L)	NR	NR	5570	2850	2410
Hydroxide as CaCO3 (mg/L)	NR	NR	2 U	2 U	2 U
Residue, Filterable (TDS) (mg/L)	NR	NR	127000	8840	9330
Residue, Non-Filterable (TSS) (mg/L)	NR	NR	NR	6 B	8 B

Notes:

B = indicates values above instrument detection limit and below contact required detection limit

U = not detected

J = estimated quality

R = data rejected during validation

NR = not reported

NA = not available

TABLE 8
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU7 - APACHE TAILING IMPOUNDMENTS

Evaluation Criteria	No Action	Simple Soil Cover			Multi-Layer Cover			Removal	
		Alone	With Groundwater Controls	Alt Channel Alignment	Alone	With Groundwater Controls	Alt Channel Alignment	With On-Site Consolidation	Deposit in On-Site Repository
	Alternative 1	Alternative 2A	Alternative 2B	Alternative 2C	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 4A	Alternative 4B
OVERALL PROTECTIVENESS									
Human Health Protection									
S Airborne transport of tailing particles	No reduction in risk.	Simple soil cover and maintenance would virtually eliminate potential for airborne transport tailing.	Same as Alternative 2A.	Same as Alternative 2A.	Greater degree of risk reduction compared to simple soil covers (Alt. 2A, 2B, 2C, and 4A) due to the use of a multi-layer soil cover and maintenance.	Same as Alternative 3A.	Same as Alternative 3A.	Same as Alternative 2A.	Same as Alternative 3A.
S Erosion of tailing materials into surface water	No reduction in risk.	Simple soil cover and maintenance would virtually eliminate potential for contact or interaction with surface water flows.	Same as Alternative 2A.	Risk virtually eliminated, however, slightly higher when compared to Alt 2A, 2B, and 4A. California Gulch channel alignment in relation to the base of the tailing could provide a slightly higher potential for interaction with surface water.	Greater degree of risk reduction compared to simple soil covers (Alt. 2A, 2B, 2C, and 4A) due to the use of a multi-layer soil cover and maintenance.	Same as Alternative 3A.	Risk virtually eliminated, however slightly higher when compared to Alt 3A, 3B, and 4B. California Gulch channel alignment in relation to the base of the tailing could provide a slightly higher potential for interaction with surface water.	Same as Alternative 2A.	Same as Alternative 3A.
S Metals leaching into surface water	No reduction in risk.	Simple soil cover and maintenance would virtually eliminate potential for contact or interaction with surface water flows.	Same as Alternative 2A.	Risk virtually eliminated, however, slightly higher when compared to Alt 2A, 2B, and 4A. California Gulch channel alignment in relation to the base of the tailing could provide a slightly higher potential for interaction with surface water.	Greater degree of risk reduction compared to simple soil covers (Alt. 2A, 2B, 2C, and 4A since a multi-layer cap will be in use.	Same as Alternative 3A.	Risk virtually eliminated, however slightly higher when compared to Alt 3A, 3B, and 4B. California Gulch channel alignment in relation to the base of the tailing could provide a slightly higher potential for interaction with surface water.	Same as Alternative 2A.	Same as Alternative 3A.
S Metals leaching into ground water	No reduction in risk.	Most surface water would be flow off the cap and not infiltrate the tailing. Slight potential still exists for minor infiltration.	Slightly greater degree of protection over Alt 2A and 4A since groundwater control system will be in use.	Slightly less degree of protection (short-term) compared to Alt 2A and 4a due to instability of tailing during excavation/construction.	Slightly greater degree of protection over Alt 2A and 4A since a multi-layer cap will be in use.	Slightly greater degree of protection over Alt 3A and 4B since groundwater control system will be in use.	Slightly less degree of protection (short-term) compared to Alt 3A and 4B due to instability of tailing during excavation/construction.	Same as Alternative 2A.	Same as Alternative 3A.
Environmental Protection	No reduction in risk.	Simple soil cover and maintenance would virtually eliminate potential for risk to environment.	Same as Alternative 2A.	Risk virtually eliminated, however slightly higher when compared to Alt 2A, 2B, and 4A. California Gulch channel alignment in relation to the base of the tailing could provide a slightly higher potential for interaction with surface water and impact to the environment.	Greater degree of risk reduction compared to simple soil covers (Alt. 2A, 2B, 2C, and 4A) due to the use of a multi-layer soil cover and maintenance.	Same as Alternative 3A	Risk virtually eliminated, however slightly higher when compared to Alt 3A, 3B, and 4B. California Gulch channel alignment in relation to the base of the tailing could provide a slightly higher potential for interaction with surface water and impact to the environment.	Same as Alternative 2A.	Same as Alternative 3A.
COMPLIANCE WITH ARARs									
Chemical-specific	Does not comply with chemical-specific ARARs.	Chemical-specific ARARs for OU7 are met.	Chemical-specific ARARs for OU7 are met.	Chemical-specific ARARs for OU7 are met.	Chemical-specific ARARs for OU7 are met.	Chemical-specific ARARs for OU7 are met.	Chemical-specific ARARs for OU7 are met.	Chemical-specific ARARs for OU7 are met.	Chemical-specific ARARs for OU7 are met.
Location-specific	Does not comply with location-specific ARARs.	The presence of cultural resource site 5LK891 in the work area may necessitate a Mitigation Plan to preserve the site's historical significance.	The presence of cultural resource site 5LK891 in the work area may necessitate a Mitigation Plan to preserve the site's historical significance.	The presence of cultural resource site 5LK891 in the work area may necessitate a Mitigation Plan to preserve the site's historical significance.	The presence of cultural resource site 5LK891 in the work area may necessitate a Mitigation Plan to preserve the site's historical significance.	The presence of cultural resource site 5LK891 in the work area may necessitate a Mitigation Plan to preserve the site's historical significance.	The presence of cultural resource site 5LK891 in the work area may necessitate a Mitigation Plan to preserve the site's historical significance.	Location-specific ARARs are met.	Location-specific ARARs are met.
Action-specific	Does not comply with action-specific ARARs.	Action-specific ARARs are met.	Action-specific ARARs are met.	Action-specific ARARs are met.	Action-specific ARARs are met.	Action-specific ARARs are met.	Action-specific ARARs are met.	Action-specific ARARs are met.	Action-specific ARARs are met.
Other criterion or guidance	None identified.	None identified.	None identified.	None identified.	None identified.	None identified.	None identified.	None identified.	None identified.

TABLE 8 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU7 - APACHE TAILING IMPOUNDMENTS

Evaluation Criteria	No Action	Simple Soil Cover			Multi-Layer Cover			Removal	
		Alone	With Groundwater Controls	Alt Channel Alignment	Alone	With Groundwater Controls	Alt Channel Alignment	With On-Site Consolidation	Deposit in On-Site Repository
	Alternative 1	Alternative 2A	Alternative 2B	Alternative 2C	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 4A	Alternative 4B
OVERALL PROTECTIVENESS									
Magnitude of Residual Risk									
- Airborne transport of tailing particles	No significant increase in long-term effectiveness and permanence.	Soil cover, regraded slopes, and maintenance would provide good long-term effectiveness and permanence.	Same as Alternative 2A	Slightly less than Alt. 2A, 2B, and 4A due to less stability of channel embankment slopes.	Multi-layer cover and regraded slopes would provide very good long-term effectiveness and permanence.	Same as Alternative 3A.	Slightly less than Alt 3A due to general stability of channel embankment slopes.	Same as Alternative 2A.	Same as Alternative 3A.
- Erosion of tailing materials into surface water	No significant increase in long-term effectiveness and permanence.	Soil cover, regraded slopes, and maintenance would provide good long-term effectiveness and permanence.	Same as Alternative 2A	Slightly less than Alt 2A, 2B, and 4A due to less stability of channel embankment slopes.	Multi-layer cover and regraded slopes would provide very good long-term effectiveness and permanence.	Same as Alternative 3A.	Slightly less than Alt 3A due to general stability of channel embankment slopes.	Same as Alternative 2A.	Same as Alternative 3A.
- Metals leaching into surface water	No significant increase in long-term effectiveness and permanence.	Soil cover, regraded slopes, and maintenance would provide good long-term effectiveness and permanence.	Same as Alternative 2A	Slightly less than Alt 2A, 2B, and 4A due to less stability of channel embankment slopes.	Multi-layer cover and regraded slopes would provide very good long-term effectiveness and permanence.	Same as Alternative 3A.	Slightly less than Alt 3A due to general stability of channel embankment slopes.	Same as Alternative 2A.	Same as Alternative 3A.
- Metals leaching into ground water	No significant increase in long-term effectiveness and permanence.	Soil cover, regraded slopes, and maintenance would provide good long-term effectiveness and permanence.	Same as Alternative 2A	Slightly less than Alt 2A, 2B, and 4A due to less stability of channel embankment slopes.	Multi-layer cover and regraded slopes would provide very good long-term effectiveness and permanence.	Same as Alternative 3A.	Slightly less than Alt 3A due to general stability of channel embankment slopes.	Same as Alternative 2A.	Same as Alternative 3A.
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Soil cap will provide good control of tailing material. Reliability of cap can be high if maintained. Failure to maintain cap can increase potential for airborne transport, erosion to surface water, and leaching to surface and groundwater. Institutional controls are limited in effectiveness due to enforceability	Same as Alternative 2A Institutional controls are limited in effectiveness due to enforceability	Reliability would be slightly less than Alternative 2A due to the channel embankment slopes being slightly less stable. Institutional controls are limited in effectiveness due to enforceability.	Reliability would be slightly greater than Alternative 2A due to the use of a multilayer cap. Institutional controls are limited in effectiveness due to enforceability.	Same as Alternative 3A. Institutional controls are limited in effectiveness due to enforceability	Reliability would be slightly less than Alternative 3A due to the channel embankment slopes being slightly less stable. Institutional controls are limited in effectiveness due to enforceability	Same as Alternative 2A. Institutional controls are limited in effectiveness due to enforceability.	Same as Alternative 3A. Institutional controls are limited in effectiveness due to enforceability.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT									
Treatment Process Used	None.	None.	None.	None.	None.	None.	None.	None.	None.
Amount Destroyed or Treated	None.	None.	None.	None.	None.	None.	None.	None.	None.
Reduction of Toxicity, Mobility or Volume	Previous removal action resulted in 16% reduction in metals (as measured by dissolved zinc) loading to groundwater.	Metals loading to groundwater reduced by 88%.	Same as Alternative 2A.	Same as Alternative 2A.	Metals loading to groundwater reduced by 96%.	Same as Alternative 3A.	Same as Alternative 3A.	Same as Alternative 3A.	Same as Alternative 3A.
Irreversible Treatment	None.	None.	None.	None.	None.	None.	None.	None.	None.
Type and Quantity of Residuals Remaining After Treatment	All tailing material will remain at OU7.	All tailing material will remain at OU7.	All tailing material will remain at OU7.	All tailing material will remain at OU7.	All tailing material will remain at OU7.	All tailing material will remain at OU7.	All tailing material will remain at OU7.	Tailing material remains untreated but relocated to another area within the California Gulch Superfund Site.	Tailing material remains untreated but relocated to another area within the California Gulch Superfund Site.

TABLE 8 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-7 APACHE TAILING IMPOUNDMENTS

Evaluation Criteria	No Action	Simple Soil Cover			Multi-Layer Cover			Removal	
		Alone	With Groundwater Controls	Alt Channel Alignment	Alone	With Groundwater Controls	Alt Channel Alignment	With On-Site Consolidation	Deposit in On-Site Repository
	Alternative 1	Alternative 2A	Alternative 2B	Alternative 2C	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 4A	Alternative 4B
SHORT-TERM EFFECTIVENESS									
Community Protection	Continued risk to community through no action	Minor risk to community due to increase in dust production, sediment transport, and surface water management during remedial activities. Controllable through use of standard construction practices.	Same as Alternative 2A.	More risk to community as compared to Alternative 2A due to excavation activities.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 3C.	Low community protection due to increased dust emissions and increased potential for accidents along haul routes.	Same as Alternative 4A.
Worker Protection	No risk to workers.	Potential for inhalation of airborne particles during grading activities.	Same as Alternative 2A.	Increase risk to workers due to excavation activities.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 3C.	Increased risk to workers due to increased dust emissions, extensive excavation, and increased potential for accidents along haul routes.	Same as Alternative 4A.
Environmental Impacts	Continued impact from existing conditions.	Minor risk to environment due to increase in dust protection, sediment transport, and surface water management during remedial activities. Controllable through use of standard construction practices.	Same as Alternative 2A.	More risk to the environment as compared to Alternative 2A due to excavation activities.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 3C.	Low short-term effectiveness due to increased dust emissions and increased potential for accidents along haul routes. Extensive controls may be required.	Low short-term effectiveness due to increased dust emissions and increased potential for accidents along haul routes. Extensive controls may be required.
Time Until Action is Complete	Not applicable.	Two years.	Two years.	Two to three years.	Two years.	Two years.	Two to three years.	Two to three years.	Two to three years.
IMPLEMENTABILITY									
Ability to Construct and Operate	No construction or operation.	Relatively standard construction. Challenge exists with excavating and grading wet tailing in some areas.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Relatively standard construction. Challenge exists with excavating large volume of tailing material and water handling activities.	Same as Alternative 4A.
Ease of Doing More Action if Needed	May require ROD amendment if future action is taken.	The integrity of the cap would have to be compromised to implement additional actions within the tailing area. Additional actions outside the tailing pile footprint should not pose a problem.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.
Ability to Monitor Effectiveness	No monitoring.	Monitoring and maintenance inspections will give notice of failure significant exposure occurs.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval necessary.	Coordination with and cooperation with property owners will be necessary. Local construction permits will not be necessary since all construction activities are within the OU 7 boundaries.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Coordination with and cooperation with property owners and management from Hecla Tailing Impoundment will be necessary. Local construction permits may be necessary since all construction activities are not within the OU 7 boundaries.	Coordination with and cooperation with property owners and management from Oregon Gulch Tailing Impoundment will be necessary since all construction activities are not within the OU 7 boundaries.
Availability of Equipment, Specialist, and Materials	None required.	Standard grading and excavating equipment is readily available.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Standard grading, excavating, and hauling equipment is readily available.	Same as Alternative 4A.
Availability of Technologies	None required.	Grading and cap technology readily available.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Same as Alternative 2A.	Hauling grading, excavation, and cap technology readily available.	Same as Alternative 4A.

TABLE 8 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-7 APACHE TAILING IMPOUNDMENTS

Evaluation Criteria	No Action	Simple Soil Cover			Multi-Layer Cover			Removal	
		Alone	With Groundwater Controls	Alt Channel Alignment	Alone	With Groundwater Controls	Alt Channel Alignment	With On-Site Consolidation	Deposit in On-Site Repository
	Alternative 1	Alternative 2A	Alternative 2B	Alternative 2C	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 4A	Alternative 4B
COSTS									
Capital Cost	$ 0	$2,055,090	$2,396,340	$2,554,533	$2,053,762	$2,845,012	$3,003,206	$11,204,008	$12,490,816
Annual O & M Cost	$ 0	$85,428	$85,428	$85,428	$85,428	$85,428	$85,428	$85,428	$85,428
Present Worth Cost (5% rate of return, 30 year period)	$ 0	$3,641,883	$3,973,383	$4,127,057	$4,077,736	$4,409,236	$4,562,910	$12,060,114	$13,177,157
STATE ACCEPTANCE									
State Acceptance	Alternative not preferred by the State.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Alternative preferred by the State.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
COMMUNITY ACCEPTANCE									
Community Acceptance	Alternative not preferred by the community.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Alternative preferred by the community.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.

TABLE 9
SUMMARY OF CHEMICAL-SPECIFIC ARARS
OU7 - APACHE TAILING IMPOUNDMENT

Standard, Requirement Criteria, or Limitation	Citation	Applicable	Relevant and Appropriate	Description
FEDERAL				
RCRA Subtitle C	40 CFR Part 261.4 (b)(7) and RCRA Section 3001 (b) (Bevill Amendment)	No	No	RCRA Subtitle C is not applicable or relevant and appropriate because the source material (tailing) has been identified as an extraction or beneficiation waste that is specifically exempted from the definition of a hazardous waste.
Clean Air Act, National Primary and Secondary Ambient Air Quality Standards	42 USC Section 7401-7642 40 CFR Part 50	Yes	---	National ambient air quality standards (NAAQS) are implemented through the New Source Review Program and State Implementation Plans (SIP). The federal New Source Review program address only major sources. Emissions associated with proposed remedial action in OU7 will be limited to fugitive dust emissions associated with earth moving activities during construction. These activities will not constitute a major source. Federal NAAQS more stringent than State standards may be applicable. See Colorado Air Pollution Prevention and Control Act concerning applicability of requirements implemented through the SIP.
STATE OF COLORADO				
Colorado Air Pollution Prevention and Control Act Regulation No. 8	5 CCR 1001-14; 5 CCR 1001-10 Part C (I) Regulation 8	Yes	---	Regulation 8 sets emission limits for lead. Applicants are required to evaluate whether the proposed activities would result in an exceedance of this standard. The proposed remedial action in OU7 is not projected to exceed the emission levels for lead, although some lead emissions may occur. Compliance with Regulation 8 will be achieved by adhering to a fugitive emissions control plan prepared in accordance with Regulation No. 1. This plan will discuss monitoring requirements, if any, necessary to achieve these standards.
Colorado Ambient Air Quality Standards	5 CCR 1001	Yes	---	Primary and secondary standards for PMl0 in ambient air. Compliance with ambient air standards will be achieved by adhering to a fugitive emissions dust control plan prepared in accordance with Regulation No. 1. This plan will discuss monitoring requirements, if any, necessary to achieve these standards.

TABLE 10
SUMMARY OF LOCATION-SPECIFIC ARARS
OU7 - APACHE TAILING IMPOUNDMENT

Standard, Requirement Criteria, or Limitation	Citation	Applicable	Relevant and Appropriate	Description
FEDERAL				
National Historic Preservation Act (NHPA)	16 USC § 470 et seq. A portion of 40 CFR § 6.301(b) 36 CFR Part 63, Part 65, Part 800	Yes	---	Expands historic preservation programs; requires preservation of resources included in or eligible for listing on the National Register for Historic Places (NRHP). Archeological/cultural resource surveys have been conducted in satisfaction of the requirements of the NHPA. A portion of OU7 (stamp mill site) has been recommended as eligible for listing on the NRHP. Therefore the NHPA is applicable.
Executive Order 11593 Protection and Enhancement of the Cultural Environment	16 USC § 470	Yes	---	Directs federal agencies to institute procedures to ensure programs contribute to the preservation and enhancement of non-federally owned historic resources. Consultation with the Advisory Council on Historic Preservation is required if remedial activities should threaten cultural resources. Compliance with the applicable provisions of the order will be achieved by implementing an approved mitigation plan if cultural resources are threatened, and through working with the Advisory Council to ensure that any threatened cultural resources are appropriately preserved.
The Historic and Archaeological Data Preservation Act of 1974	16 USC 469 40 CFR § 6.301©)	Yes	---	Establishes procedures to preserve historical and archeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity program. A cultural resource survey was completed in OU7 to identify historic properties which may be affected by remedial activity. Compliance with the Act will be addressed by implementing an approved mitigation plan, if cultural resources are threatened.
Historic Sites Act of 1935	16 USC § 461-467	No	No	Preserves for public use historic sites, buildings, and objects of natural significance. Is potentially applicable if any site feature is determined to be of natural significance. Compliance with the requirements would be addressed by the mitigation plan.
The Archeological Resources Protection Act of 1979	16 USC §§ 470aa-47011	No	Yes	Requires a permit for any excavation or removal of archeological resources from public lands or Indian lands. May be relevant and appropriate if archeological resources encountered during remedial activity.
Executive Order No. 11990 Protection of Wetlands	40 CFR § 6.302(a) and Appendix A	Yes	---	Minimizes adverse impacts on areas designated as wetlands. Wetlands have been identified in adjacent areas which may be impacted by the remedial actions. Mitigation of impacts to the adjacent wetlands will be addressed in the remedial design report for OU7.

TABLE 10 (continued)
SUMMARY OF LOCATION-SPECIFIC ARARS
OU7 - APACHE TAILING IMPOUNDMENT

Standard, Requirement Criteria, or Limitation	Citation	Applicable	Relevant and Appropriate	Description
Executive Order No. 11988 Floodplain Management	40 CFR § 6.302 & Appendix A	Yes	---	Pertains to floodplain management and construction and impoundments in such areas. OU7 is located within the flood plain of California Gulch. The remediation must be conducted to avoid long- and short-term impacts associated with the occupation or modification of the flood plain.
Resource Conservation and Recovery Act (RCRA), Subtitle D	40 CFR Part 257, Subpart A, § 257.3-1 Floodplains, paragraph (a)	No	Yes	Provides general classification criteria for solid waste disposal facilities pertaining to floodplains. As the remedial actions for OU7 may involve establishment of a solid waste disposal facility, portions of this regulation are relevant and appropriate. This regulation prohibits siting a facility for treatment, storage, or disposal of solid waste within the 100-year floodplain so as to avoid restriction of the base flood, reduction in temporary water storage capacity, and washout of solid waste.
Section 404, Clean Water Act (CWA)	33 USC 1251 et seq. 33 CFR Part 330	Yes	---	Regulates discharge of dredged or fill materials into waters of the United States. Substantive requirements of portions of Nationwide Permit No. 38 (General and Specific Conditions) are applicable to OU7 remedial activities conducted within waters of the United States. The remedial actions will be designed to comply with these requirements.
Fish and Wildlife Coordination Act	16 USC § 661 et seq. 40 CFR § 6.302	No	No	Requires coordination with federal and state agencies to provide protection of fish and wildlife in water resource development programs; regulates actions that impound, divert, control, or modify any body of water. However, proposed remedial action activities in OU7 will not affect fish or wildlife. If it appears that remedial activities may impact wildlife resources, EPA will coordinate with both the U.S. Fish and Wildlife Service and the Colorado Department of Natural Resources.
Endangered Species Act	16 USC § 1531 et seq. 50 CFR §§ 200 and 402	No	No	Provides protection for threatened and endangered species and their habitats. However, site-specific studies did not document the presence of threatened or endangered species. If threatened or endangered species are encountered during remedial activities in OU7, then requirements of Act would be applicable.
Wilderness Act	16 USC 1311, 16 USC 668 50 CFR 53, 50 CFR 27	No	No	Limits activities within areas designated as wilderness areas or National Wildlife Refuge Systems.

TABLE 10 (continued)
SUMMARY OF LOCATION-SPECIFIC ARARS
OU7 - APACHE TAILING IMPOUNDMENT

Standard, Requirement Criteria, or Limitation	Citation	Applicable	Relevant and Appropriate	Description
STATE OF COLORADO				
Colorado Register of Historic Places	CRS §§ 24-80.1-101 to 108	Yes	---	Establishes requirements for protecting properties of historical significance. Are applicable if remedial actions impact any property listed on the Register of Historic Places.
Colorado Historical, Prehistorical, and Archaeological Resources Act	CRS §§ 24-80-401 to 410 1301 to 1305	No	Yes	Concerns historical, prehistorical, and archaeological resources; applies only to areas owned by the State or its political subdivisions. May be relevant and appropriate if remedial action impacts an archaeological site.
Colorado Species of Special Concern and Species of Undetermined Status	Colorado Division of Wildlife Administrative Directive E-1, 1985, modified	No	No	Protects species listed on the Colorado Division of Wildlife generated list. Urges coordination with the Division of Wildlife if wildlife species are to be impacted. No evidence of species of special concern have been identified at this site.
Nongame, Endangered or Threatened Species Act	CRS §§ 33-2-101 to 108	No	No	Standards for regulation of nongame wildlife and threatened and endangered species. Site-specific studies did not document the presence of threatened or endangered species. If threatened or endangered species are encountered during remedial activities in OU7, then requirements of Act will be applicable.
Colorado Natural Areas	Colorado Revised Statutes, Title 33 Article 33, Section 104	No	No	Maintains a list of plant species of "special concern." Although not protected by State statue, coordination with Division of Parks and Outdoor Recreation is recommended if activities will impact listed species.
Colorado Solid Waste Disposal Sites and Facilities Act	6 CCR 1007-2, Part I	No	Yes	Establishes regulations for solid waste management facilities, including location standards. As the remedial actions for OU7 may involve establishment of a solid waste disposal facility, portions of this regulation are relevant and appropriate.

TABLE 11
SUMMARY OF ACTION-SPECIFIC ARARS
OU7 - APACHE TAILING IMPOUNDMENT

Standard, Requirement Criteria, or Limitation	Citation	Applicable	Relevant and Appropriate	Description
FEDERAL				
Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976 (RCRA)	40 CFR Part 257, Subpart A: § 257.3-1 Floodplains, paragraph (a); § 257.3-7 Air, paragraph (b)	Yes	---	Selected portions of Part 257 pertaining to floodplains and air are applicable. These provisions establish criteria for classification of solid waste disposal facilities and practices. The applicable requirements will be addressed by the remedial designs.
Hazardous Materials Transportation Act	49 USC § 1801-1813 49 CFR 107, 171-177	No	No	Regulates transportation of hazardous materials. Proposed remedial action in OU7 will be conducted will not entail off-site transportation of hazardous materials.
STATE OF COLORADO				
Colorado Air Pollution Prevention and Control Act, Fugitive Dust Control Plan/Opacity Regulation No. 1	5 CCR 1001-3; Section III.D;1.b,c,d; 2a(i)(ii) Sections II.D.2.b,c,e,f,g Regulation 1	Yes	---	Regulation No. 1 provisions concerning fugitive emissions for construction activities, storage and stockpiling activities, haul roads, haul trucks, and tailing ponds are applicable (5 CCR 1001-3; Sections II.D.2.b,c,e,f,g). Construction activities in OU7 will be conducted in accordance with a fugitive emissions control plan.
Colorado Air Pollution Prevention and Control Act, APENs Regulation No. 3	5 CCR 1001-5 Regulation 3	Yes	---	Substantive requirements of an Air Pollution Emission Notice (APEN) are applicable if the removal actions disturb contaminated soil. An APEN will be filed, although permitting requirements such as this are typically not required under CERCLA.
Colorado Air Pollution Prevention and Control Act, Odors Regulation 2	5 CCR 1001-4 Regulation No. 2	Yes	--	Applicable only if remedial action activities cause objectionable odors. Remedial action in OU7 is not expected to produce odors.
Colorado Hazardous Waste Regulations	6 CCR 1007-3, Part 264: Section 264.301,(g),(h),(i), and (j); Section 264.310, (a)(1) through (a)(4); Section 264.310, (b)(1) and (b)(5)	No	Yes	These specific provisions of the hazardous waste regulations may be relevant and appropriate for conducting remedial actions in OU7. Specific provisions of Section 264.301 concern run-on control, run-off control, management of run-on and run-off control systems, and wind dispersal. This regulation requires run-off control for the 100-year, 24-hour storm. Specific provisions of Section 264.310 concern placement of a cover to minimize infiltration, minimize maintenance, promote drainage and minimize erosion, and accommodate settling. Post-closure requirements are also included in this regulation to: maintain integrity and effectiveness of the final cover by making repairs, as necessary; and prevent erosion of the final cover.

TABLE 11 (continued)
SUMMARY OF ACTION-SPECIFIC ARARS
OU7 - APACHE TAILING IMPOUNDMENT

Standard, Requirement Criteria, or Limitation	Citation	Applicable	Relevant and Appropriate	Description
Colorado Solid Waste Disposal Sites and Facilities Act	6 CCR 1007-2	No	Yes	Establishes standards for licensing, locating, constructing and operating solid waste facilities. This regulation is potentially relevant and appropriate if the remedial actions include establishment of a solid waste disposal facility. This regulation includes restrictions and site standards to address: protection of the facility from wind; minimization of runon from upgradient areas; isolation of the public and environment; engineering design requirements; and stability of the final surface.
Colorado Discharge Permit System Regulations	5 CCR 1002-61	Yes	---	Establishes requirements for storm water discharges (except portions relating to Site-wide Surface and Groundwater). Substantive requirements for storm water discharges associated with construction activities are applicable.
Colorado Mined Land Reclamation Act	CRS 34-32-101 to 125 Rule 3 of Mineral Rules and Regulations	No	Yes	Regulates all aspects of land use for mining, including the location of mining operations and related reclamation activities and other environmental and socio-economic impacts. Substantive requirements of selected portions of Rule 3 regarding Reclamation Measures (grading, erosion and filtration control, and handling of acid-forming or toxic materials); Water - General Requirements (hydrology, dredge and fill, and slope stabilization, except portions relating to Side-wide Surface and Ground Water), Wildlife, and Revegetation are potentially relevant and appropriate.
Colorado Noise Abatement Act	CRS §§ 25-12-101 to 108	Yes	---	Established maximum permissible noise levels for particular time periods and land use related to construction projects.
Regulations on the Collection of Aquatic Life	2 CCR 406-8, Ch. 13, Article III, Sec. 1316	No	No	Requirements governing the collection of wildlife for scientific purposes. Remedial activities within OU7 will not include biological monitoring.

TABLE 12
SUMMARY OF GROUNDWATER
MASS LOADING REDUCTIONS
OU7 - APACHE TAILING IMPOUNDMENTS

ALTERNATIVE	DISSOLVED ZINC LOADING	
	POUNDS PER YEAR	PERCENT REDUCTION
Existing Conditions	14,509	0%
Alternative 1	12,193	16%
Alternative 2A	1,716	88%
Alternative 2B	1,716	88%
Alternative 2C	1,716	88%
Alternative 3A	563	96%
Alternative 3B	563	96%
Alternative 3C	563	96%
Alternative 4A	524	96%
Alternative 4B	524	96%

ALTERNATIVES:

Existing conditions: Prior to removal of Tailing Ponds Nos. 2 and 3.

Alternative 1: No action (beyond removal of Tailing Ponds Nos. 2 and 3).
Alternative 2A: Cover soil + 6" drainage layer + 12" compacted tailing over tailing.
Alternative 2B: Alternative 2A plus groundwater controls.
Alternative 3A: Cover soil + drainage net + geosynthetic clay liner over tailing.
Alternative 3B: Alternative 3A plus groundwater controls.
Alternative 4A: Removal and on-site consolidation.
Alternative 4B: Removal and disposal in an on-site repository.

TABLE 13
SURFACE WATER AND GROUNDWATER PERFORMANCE MONITORING
OU7 - APACHE TAILING IMPOUNDMENTS

PROPOSED MONITORING LOCATIONS	TYPE
APDN2	Surface Water
SPR21	Surface Water
SPR27	Surface Water
SPR19	Surface Water
CGO3	Surface Water
SD1	Surface Water
SPR7	Surface Water
TPD	Surface Water
CGAO1U	Surface Water
SPR8	Surface Water
SD2	Surface Water
APD1 (new)	Surface Water
APU1 (new)	Surface Water
GAW Shaft (SPR23)	Groundwater/Surface Water
AP1TMW1	Groundwater
AP1TMW2	Groundwater
AP1TMW3	Groundwater
AP1TMW7	Groundwater
AP1TMW9	Groundwater
AP1TMW11S	Groundwater
AP1TMW11D	Groundwater
AP1TMW12S	Groundwater

TABLE 13 (continued)
SURFACE WATER AND GROUNDWATER PERFORMANCE MONITORING
OU7 - APACHE TAILING IMPOUNDMENTS

PROPOSED MONITORING LOCATIONS	TYPE
AP1TMW12D	Groundwater
AP1TMW13S	Groundwater
AP1TMW13D	Groundwater
AP1TMW14S	Groundwater
AP1TMW14D	Groundwater
AP1TMW15	Groundwater
AP1TMW16S	Groundwater
AP1TMW16D	Groundwater
AP1TMW17	Groundwater
AP1TMW18	Groundwater
NW16	Groundwater
NW3	Groundwater
P34R	Groundwater
AP1PZ19	Groundwater
AP1PZ20	Groundwater
AP1PZ21	Groundwater
NW5A	Groundwater
NW5D	Groundwater
NW5C	GW

Note:
Proposed monitoring locations are shown on Figure 3.

TABLE 14
DETAILED COST ESTIMATE
ALTERNATIVE 3A - SOIL COVER WITH GEOSYSNTHETIC BARRIER
OU7 - APACHE TAILING IMPOUNDMENTS

ITEM/DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
DIRECT CAPITAL COSTS				
Regrading/Excavation				
Place waste rock pre-load fill	15000	cy	1.40	$21,000
subgrade support over pond area	5300	sy	1.90	$10,070
wick drains				
mobilization/demob w/ crane	1	ls	15,000.00	$15,000
approx 10' on center	21210	lf	0.75	$15,908
Regrade embankment	25000	cy	3.00	$75,000
Excavate Cal. Gulch Channel through Main Impoundment				
excavate/load/haul	55000	cy	5.00	$275,000
place	55000	cy	2.00	$110,000
dewatering	4	month	2,500.00	$10,000
riprap	670	cy	39.50	$26,465
Cover				
excavate borrow	44360	cy	1.60	$70,976
screen 3-6" rock	44360	cy	4.00	$177,440
haul	34120	cy	1.25	$42,650
place	34120	cy	1.40	$47,768
Drainage Net	68000	sy	1.60	$108,800
geosynthetic clay liner	68000	sy	4.50	$306,00
Revegetation				
All surfaces with slope less than 3:1	11	ac	1,750.00	$19,250
3:1 slopes or greater	3.1	ac	8,500.00	$26,350
Plug Wooden Box Culvert	1	ls	5,000.00	$5,000
Upgradient Diversion Ditches				
excavate/load	2100	lf	4.00	$8,400
Dust Control	180	day	500.00	$90,000
Erosion and Sediment Control	1	ls	15,000.00	$15,000
Relocate Sewer Line				
install 8" PVC sewer pipe	1600	lf	20.00	$32,000
manholes	3	ea	900.00	$2,700
Relocate Power Line	1	ls	30,000.00	$30,000
SUBTOTAL DIRECT CAPITAL COSTS				$1,540,777
INDIRECT CAPITAL COSTS				
Mob/Demob			10%	$154,078
Engineering/Administration Costs			10%	$154,078
Construction Management Costs			10%	$154,078
SUBTOTAL INDIRECT CAPITAL COSTS				$462,233
Contingency			25%	$500,752
TOTAL ESTIMATED CAPITAL COST				**$2,503,762**
ANNUAL OPERATION & MAINTENANCE COSTS				
Incremental Annual O&M Costs				
Inspection	1	yr	1,280.00	$1,280
Erosion Repairs	1	yr	6,000.00	$6,000
Vegetation Maintenance	1	yr	6,000.00	$6,000
gw/sw Monitoring (yrs. 1-5 only)	2	events/yr	25,000.00	$50,000
SUBTOTAL ANNUAL O&M COSTS				$62,280
O&M Administration and Fees			10%	$6,328
O&M Contingency			25%	$15,820
TOTAL ANNUAL O&M COSTS				$85,428
FIVE YEAR REVIEW COSTS				
Labor - 2 Engineers ($70/hr) & 2 Technicians ($50/hr) - 1 week @ 40 hrs/wk	40	mh	240.00	$9,600
Travel	4	each	600.00	$2,400
Per diem	20	mndy	77.00	$1,540
Lab Costs	15	each	500.00	$7,500
Office/Admin	120	mh	140.00	$16,800
SUBTOTAL FIVE YEAR REVIEW COSTS				$37,840
Five Year Review Contingency			10%	$3,784
TOTAL FIVE YEAR REVIEW COSTS				$41,624
TOTAL PRESENT WORTH (5% rate of return, 30 year period)				**$4,077,736**

TABLE 15
PRESENT WORTH ANALYSIS
ALTERNATIVE 3A - SOIL COVER WITH GEOSYNTHETIC BARRIER
OU7 - APACHE TAILING IMPOUNDMENTS

Year	Capital Costs	O&M Costs	Total Annual Expenditure	Rate of Return = 3%		Rate of Return = 5%		Rate of Return = 10%	
				Discount Factor	Present Worth	Discount Factor	Present Worth	Discount Factor	Present Worth
0	$1,001,505	$0	$1,001,505	1.0000	$1,001,505	1.0000	$1,001,505	1.0000	$1,001,505
1	$1,502,257	$135,428	$1,637,685	0.9709	$1,589,986	0.9524	$1,559,700	0.9091	$1,488,805
2		$135,428	$135,428	0.9426	$127,654	0.9070	$122,837	0.8264	$111,924
3		$135,428	$135,428	0.9151	$123,936	0.8638	$116,988	0.7513	$101,749
4		$135,428	$135,428	0.8885	120,326	0.8227	$111,417	0.6830	$92,499
5		$177,052	$177,052	0.8626	$152,727	0.7835	$138,725	0.6209	$109,935
6		$85,428	$85,428	0.8375	$71,545	0.7462	$63,748	0.5645	$48,222
7		$85,428	$85,428	0.8131	$69,461	0.7107	$60,712	0.5132	$43,838
8		$85,428	$85,428	0.7894	$67,438	0.6768	$57,821	0.4665	$39,853
9		$85,428	$85,428	0.7664	$65,473	0.6446	$55,068	0.4241	$36,230
10		$127,052	$127,052	0.7441	$94,539	0.6139	$77,999	0.3855	$48,984
11		$85,428	$85,428	0.7224	$61,715	0.5847	$49,948	0.3505	$29,942
12		$85,428	$85,428	0.7014	$59,917	0.5568	$47,570	0.3186	$27,220
13		$85,428	$85,428	0.6810	$58,172	0.5303	$45,304	0.2897	$24,745
14		$85,428	$85,428	0.6611	$56,478	0.5051	$43,147	0.2633	$22,496
15		$127,052	$127,052	0.6419	$81,550	0.4810	$61,114	0.2394	$30,415
16		$85,428	$85,428	0.6232	$53,236	0.4581	$39,136	0.2176	$18,592
17		$85,428	$85,428	0.6050	$51,685	0.4363	$37,272	0.1978	$16,901
18		$85,428	$85,428	0.5874	$50,180	0.4155	$35,497	0.1799	$15,365
19		$85,428	$85,428	0.5703	$48,718	0.3957	$33,807	0.1635	$13,968
20		$127,052	$127,052	0.5537	$70,346	0.3769	$47,885	0.1486	$18,885
21		$85,428	$85,428	0.5375	$45,922	0.3589	$30,664	0.1351	$11,544
22		$85,428	$85,428	0.5219	$44,584	0.3418	$29,204	0.1228	$10,494
23		$85,428	$85,428	0.5067	$43,286	0.3256	$27,813	0.1117	$9,540
24		$85,428	$85,428	0.4919	$42,025	0.3101	$26,488	0.1015	$8,673
25		$127,052	$127,052	0.4776	$60,681	0.2953	$37,519	0.0923	$11,726
26		$85,428	$85,428	0.4637	$39,613	0.2812	$24,026	0.0839	$7,168
27		$85,428	$85,428	0.4502	$38,459	0.2678	$22,882	0.0763	$6,516
28		$85,428	$85,428	0.4371	$37,339	0.2551	$21,792	0.0693	$5,924
29		$85,428	$85,428	0.4243	$36,251	0.2429	$20,754	0.0630	$5,385
30		$127,052	$127,052	0.4120	$52,344	0.2314	$29,397	0.0573	$7,281
TOTAL PRESENT WORTH				@ 3% $4,517,087		@ 5% $4,077,736		@ 10% $3,426,327	

APPENDIX A

RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY
APACHE TAILING IMPOUNDMENT OU7
CALIFORNIA GULCH SUPERFUND SITE
LEADVILLE, COLORADO

1.0 OVERVIEW

The U.S. Environmental Protection Agency (EPA) has prepared this Responsiveness Summary to document and respond to issues and comments raised by the public regarding the Proposed Plan for the Apache Tailing Impoundments Operable Unit 7 (OU7) of the California Gulch Superfund Site. EPA's preferred alternative and the remedy selected in the Record of Decision (ROD) involves consolidation of tailing material, installation of a soil cover with a geosynthetic barrier over the tailing impoundments, surface water controls, and implementation of institutional controls. A public meeting was held on January 25, 2000 at 7:00 p.m. at the Mining Hall of Fame and Museum in Leadville, Colorado to present the preferred alternative to the public. Comments were received during the public comment period, which was originally scheduled to expire on February 25, 2000, but was extended upon request through March 27, 2000.

Comments received during the public comment period and EPA's responses, are outlined in this document. By law, the EPA and the Colorado Department of Public Health and Environment (CDPHE) must consider public input prior to making a final decision on a cleanup remedy. Once public comment is reviewed and considered, the final decision on a cleanup remedy is documented in the ROD.

Judging from the comments received during the public comment period, the residents and city council of Leadville, ASARCO Inc. (Asarco) (the potentially responsible party), and the CDPHE strongly support the preferred alternative. The community, in general, preferred installing a soil cover in place as opposed to excavating, moving, and relocating the tailings to a new location. One of the land owners, MTAA Limited (MTAA), however, did not support any of the alternatives that involved a capping remedy.

This document includes the following sections:

- Background on Recent Community Involvement
- Summary of Public Comments Received During Public Comment Period and Agency Responses
- Remaining Concerns

2.0 BACKGROUND ON RECENT COMMUNITY INVOLVEMENT

The OU7 Proposed Plan was published in January 2000 and describes the preferred cleanup alternative for Apache Tailing Impoundment. Based upon consideration of National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria, EPA determined that Alternative 3A - Soil Cover with Geosynthetic Barrier is the appropriate remedy for the tailing material at OU7. A portion of the public meeting held on January 25, 2000 was dedicated to accepting formal oral comments from the public.

The major concerns expressed during the public comment period and EPA's responses are described below:

General Comment No. 1 — *Concerns about the groundwater rising, especially during the spring runoff period, would impact the remedy.*

EPA's Response: The issues associated with rising groundwater levels and spring discharge are addressed in the Site Characterization section of the Focused Feasibility Study (FFS), and it was concluded that it is unlikely that a future rise in groundwater levels would impact the preferred remedy for the Apache Impoundments. Additionally, as determined through the additional evaluations conducted over the last year and discussed in the FFS, the oxide tailing that comprise the lower 20 to 30 feet of the impoundment do not readily leach metals and are not a significant source of metals loading to groundwater.

General Comment No. 2 — *MTAA presented an alternate proposal that involved processing the tailing material.*

EPA's Response: This plan lacked specific data and information to satisfy the CERCLA and NCP requirements for the evaluation of remedial alternatives. The EPA and the CDPHE provided preliminary comments on this plan to MTAA on April 4 and April 5, 2000, respectively. An additional public meeting was held on April 13, 2000 at the Mining Hall of Fame and Museum in Leadville, CO to allow MTAA the opportunity to present their proposal and to provide additional information in response to Agency comments.

No additional technical information was provided during the meeting. Furthermore, MTAA has not responded to EPA or CDPHE comments.

3.0 SUMMARY OF PUBLIC COMMENTS RECEIVED DURING PUBLIC COMMENT PERIOD AND AGENCY RESPONSE

The following are comments received at the formal public meeting on January 25, 2000. Ms. Rebecca Thomas of EPA and Mr. Bob Litle of Asarco began the meeting with some introductory remarks. EPA explained that an alternate reprocessing proposal, not included in the Proposed Plan, might be submitted by MTAA, the current owner of the majority of the Apache Tailing Impoundment property, for comment prior to the close of the public comment period.

Mr. Daryl Longwill of McCully, Frick & Gilman, Inc. (representing Asarco) presented the alternatives under consideration to remediate the Apache Tailing Impoundment.

A number of comments were received during the meeting and are summarized below. The comments are presented in italicized type and the responses are presented in regular type.

Comment No. 1: *Is the MTAA proposal worth commenting on?* (Lake County Commissioner Martin)

Response: We have not received an official proposal from MTAA. They must submit their proposal during the public comment period if it is to be considered. If a viable alternative is presented, another public meeting will be held to allow comment on the proposal.

Comment No. 2: *What is the conversion factor for yards to tons?* (Lake County Commissioner Martin)

Response: 1.5 to 2 tons per cubic yard.

Comment No 3: *What about the GAW and Valentine shafts which are acting like artesian wells - the groundwater level is up 30 feet since 1992? These shafts could be connected to the Leadville Mine Drainage Tunnel through faults. Water quality from these shafts is good. If groundwater continues to rise, could it create a source of contamination at Apache?* (Lake County Commissioner Martin)

Response: The issues associated with rising groundwater levels and spring discharge are addressed in the Site Characterization section of the FFS, and it was concluded that it is unlikely that a future rise in groundwater levels would impact the preferred remedy for the Apache Impoundments. The Valentine shaft is outside the area which has been observed to be affected by the rising groundwater levels in the vicinity of the GAW shaft. Groundwater levels in the vicinity of Apache peaked several years ago and are now actually trending downward, and groundwater levels beneath the impoundment (monitored since 1977) do not appear to be affected by fluctuations in the deep aquifer or through the fault systems upgradient of

Apache as evidenced by flow variations at the GAW shaft. Even if groundwater levels were to rise again, the rising water table would be limited by spring discharge at the ground surface or would flow through the more permeable soil beneath the tailing rather than impact the relatively low permeability tailing at the base of the impoundment.

Comment No. 4: *What about possible springs under the tailing impoundment?* (Lake County Commissioner Martin)

Response: It is unlikely that any water from beneath the tailing, either from a spring or rising groundwater, would impact the impoundment. The tailing is finer grain with lower permeability, so water would follow a path of least resistance, flowing horizontally beneath the impoundment through the more permeable alluvial materials. Additionally, as determined through the additional evaluations conducted over the last year and discussed in the FFS, the brown oxide tailing that comprise the lower 20 to 30 feet of the impoundment do not readily leach metals and are not a significant source of metals loading to groundwater.

Comment No. 5: *How much would groundwater have to rise before it becomes a problem?* (Bob Elder)

Response: It's unlikely that the water levels near the impoundment will rise above the levels observed during 1996 and 1997. Groundwater would need to rise or mound another 20 - 30 feet, which is above the ground surface, to come into contact with sulfide tailing.

Comment No. 6: *Wouldn't rising water contact the sulfide tailing?* (Mayor Gaede)

Response: No, even if groundwater rose again, it would either discharge at the ground surface adjacent to the impoundment or flow horizontally through the more permeable alluvial materials beneath the impoundment, following the path of least resistance.

Comment No. 7: *What about Starr Ditch?* (Dan Larkin)

Response: EPA will configure Starr Ditch this summer to ensure that it can manage spring runoff and summer storm events. Various alignment options will be considered.

Comment No. 8: *Will you use local contractors?* (John McCarty)

Response: Local contractors will be invited to bid on this work.

Comment No. 9: *Will Apache end up like the "wedding cakes" in Stray Horse Gulch - will there be any future land uses possible?* (Dan Larkin)

Response: The impoundments are located on private property. Future land use would be up to the owner, consistent with local zoning, and subject to controls to maintain the protectiveness of the remedy and containment of the tailing. The proposed remedy won't significantly increase the overall height of the impoundment and the side slopes will be gradual. There are a number of options for final grade of the impoundment.

Comment No. 10: *What about future uses?* (Mayor Gaede)

Response: Institutional controls will be placed on the property to ensure that the cap is not impacted by any future use. Future uses are possible as long as the intended use maintained the integrity of the remedy. (Also see response to previous comment.)

Comment No. 11: *What about the MTAA proposal?* (Roger Peterson)

Response: We know that MTAA prefers a reprocessing alternative, although we have not yet seen an official proposal from them.

Comment No. 12: *Any reprocessing alternative would go broke.* (Lake County Commissioner Martin)

Response: Comment noted.

Comment No. 13: *What's the cost difference between capping and removal? How difficult is it to move the tailing?* (Roger Peterson)

Response: The capital cost for EPA's preferred alternative, soil cover with geosynthetic barrier, is estimated to be $4,078,000. The capital cost for removal options range from $11,204,000 to $12,491,000, depending on location of the waste repository. There are problems associated with moving the tailing since they are saturated and difficult to contain.

Comment No. 14: *What about creating a slurry from the tailing and transporting it in a pipe?* (Bob Elder)

Response: Transportation may not be as potentially detrimental as trucking, but it would still be an engineering challenge, creating difficult water supply and water treatment issues as well as necessitating the construction of a slurry plant.

Comment No. 15: *A few comments regarding reprocessing as an alternative. In 1996, Asarco publicly requested proposals to reprocess the Apache Tailing material as an option. Several firms expressed interest and obtained samples, however, Asarco received no proposals. Based on this lack of response and information available to Asarco, we have determined that the recovery of base and/or precious metals from the tailing using a flotation process is not economically viable. Concerning use of the Black Cloud Mill to reprocess Apache tailing, Asarco noted that they must be responsible to their shareholders and would be reluctant to co-mingle waste from a Superfund Site with the Black Cloud Mine.* (Bob Litle, Asarco)

Response: Comment noted.

Comment No. 16: *More comments regarding reprocessing as alternative.* (Bob Elder)

Asarco would have made pyritic concentrate from the Apache tailing if it was feasible. The Apache Mill created problems with Tailing Ponds No. 2 and 3 when they were attempting to reprocess the tailing for pyrite.

Response: Comment noted.

In addition to the comments received during the pubic meeting, the following written comments were received during the public comment period.

Written Comment No. 1: *In a letter dated March 21, 2000, MTAA opposes the capping plan for the Apache Tailing Impoundment because a cap would render the property and tailing useless. In addition, MTAA raised concerns regarding rising groundwater during spring runoff, seismic activity, and long-term integrity of the cap.*

Response: Future land use would be determined by the owner, consistent with local zoning, and subject to controls to maintain the protectiveness of the remedy and containment of the tailing. Institutional controls will be placed on the property to ensure that the cap is not impacted by any future use. Future uses are possible as long as the intended use maintained the integrity of the remedy.

The issues associated with rising groundwater levels and spring discharge are addressed comments Nos. 3, 4, 5, and 6, in the Site Characterization section of the FFS, and it was concluded that it is unlikely that a future rise in groundwater levels would impact the preferred remedy for the Apache Impoundments.

The design, construction, and maintenance of the soil barrier will be in compliance with the Work Area Management Plan (WAMP). The design will ensure long-term integrity of the remedy. The cap will also be designed to withstand predicted seismic activity in the area.

Additional response to the seismic concerns are related to information contained in a 1998 Colorado Geologic Survey Report. This referenced report is Open-File Report 98-8, Preliminary Quaternary Fault and Fold Map and Database of Colorado. This preliminary report is a compilation of available data from previously published and non-published literature on quaternary faults and folds in Colorado. This report does not present new information nor does it provide all of the information necessary to evaluate seismic risk such as peak ground acceleration associated with a fault system or area, or recurrence intervals to determine the probability of the occurrence of seismic activity.

The slope stability analyses performed as part of the FFS for the Apache Tailing Impoundments site included an evaluation of the impoundment under seismic (pseudo-static) conditions. In performing these analyses a ground acceleration factor is applied in the slope stability model to represent potential seismic conditions. Ground acceleration, or ground motion, is typically expressed as a fraction of the acceleration of gravity (g). Following standard engineering practice, a probabilistic approach was used to determine the appropriate ground acceleration based on the probability of a given event being exceeded (or not exceeded) during a given time period. Several references were utilized including guidelines developed by the U.S. Army Corps of Engineers (USACE, 1983/1995) and a United States Geological Survey (USGS) publication of National Seismic-Hazard Maps (Frankel, et al., 1996). Based on these references, a horizontal seismic coefficient (peak ground acceleration) of 0.05g was selected to represent potential earthquake loading at the site using a 10 percent probability of exceedance in a 50-year period. The 10 percent probability of exceedance in 50 years corresponds to an annual frequency of exceedance of 2.1×10^{-3} (Frankel, et al., 1996), or inversely a recurrence interval, or return period, of approximately 475 years. In preparing the National Seismic-Hazard Maps the USGS used a maximum moment magnitude of 6.5 for the Rocky Mountain Region and the Colorado Plateau, consistent with the magnitude of the largest historic events in the regions (Frankel, et al., 1996).

Results of the slope stability analyses presented in the FFS indicate that each of the regraded slope geometries analyzed had factors of safety greater than the minimum acceptable values using a horizontal ground acceleration value of 0.05g.

References

Frankel, A., C. Mueller, T. Barnhard, D. Perkins, E.V. Leyendecker, N. Dickman, S. Hanson, and M. Hooper. 1996. *National Seismic-Hazard Maps: Documentation* June 1996, United States Geological Survey (USGS) Open File Report 96-532.

U.S. Army Corps of Engineers (USACE), 1983/1995. *Earthquake Design and Analysis for Corps of Engineers Projects.* Regulation No. 1110-1806. (Revised July 31, 1995).

Written Comments No. 1 through 13: *In separate letters dated March 24, 2000, twelve (12) Leadville residents expressed their support to EPA for Alternative 3A, Soil Cover with a Geosynthetic Barrier, at the Apache Tailing Impoundment, Operable Unit 7 within the California Gulch Superfund Site.*

Response: Comment noted.

Written Comment No. 14 *In a letter dated March 24, 2000, the Leadville Mayor Gaede expressed Leadville's concern about the future development of the site.*

Response: The impoundment is located on private property. Future land use would be determined by the owner, consistent with local zoning, and subject to controls to maintain the protectiveness of the remedy and containment of the tailing. Institutional controls will be placed on the property to ensure that the cap is not impacted by any future use. Future uses are possible as long as the intended use maintained the integrity of the remedy.

Written Comment No. 15 *On March 28, 2000, EPA received an alternate proposal for consideration from MTAA Ltd. The alternate proposal generally described processing the Apache Tailing Impoundment material to produce pyrite for a glass or foundry additive and to recover and refine silver and gold.*

Response: A public meeting held on April 13, 2000 at 7:00 p.m. at the Mining Hall of Fame in Leadville, Colorado to allow MTAA to provide a more detailed description of their proposal. A public notice was placed in the Herald Democrat newspaper on April 6, 2000 announcing the upcoming meeting and the location where the MTAA's proposal can be reviewed.

MTAA did not provide any further technical information at the time of public meeting.

Public comment was accepted on the MTAA proposal through April 17, 2000. Only one comment was received from the Lake County Commissioners in a letter dated April 17, 2000. The Commissioners found the proposal highly questionable and, in part, ludicrous.

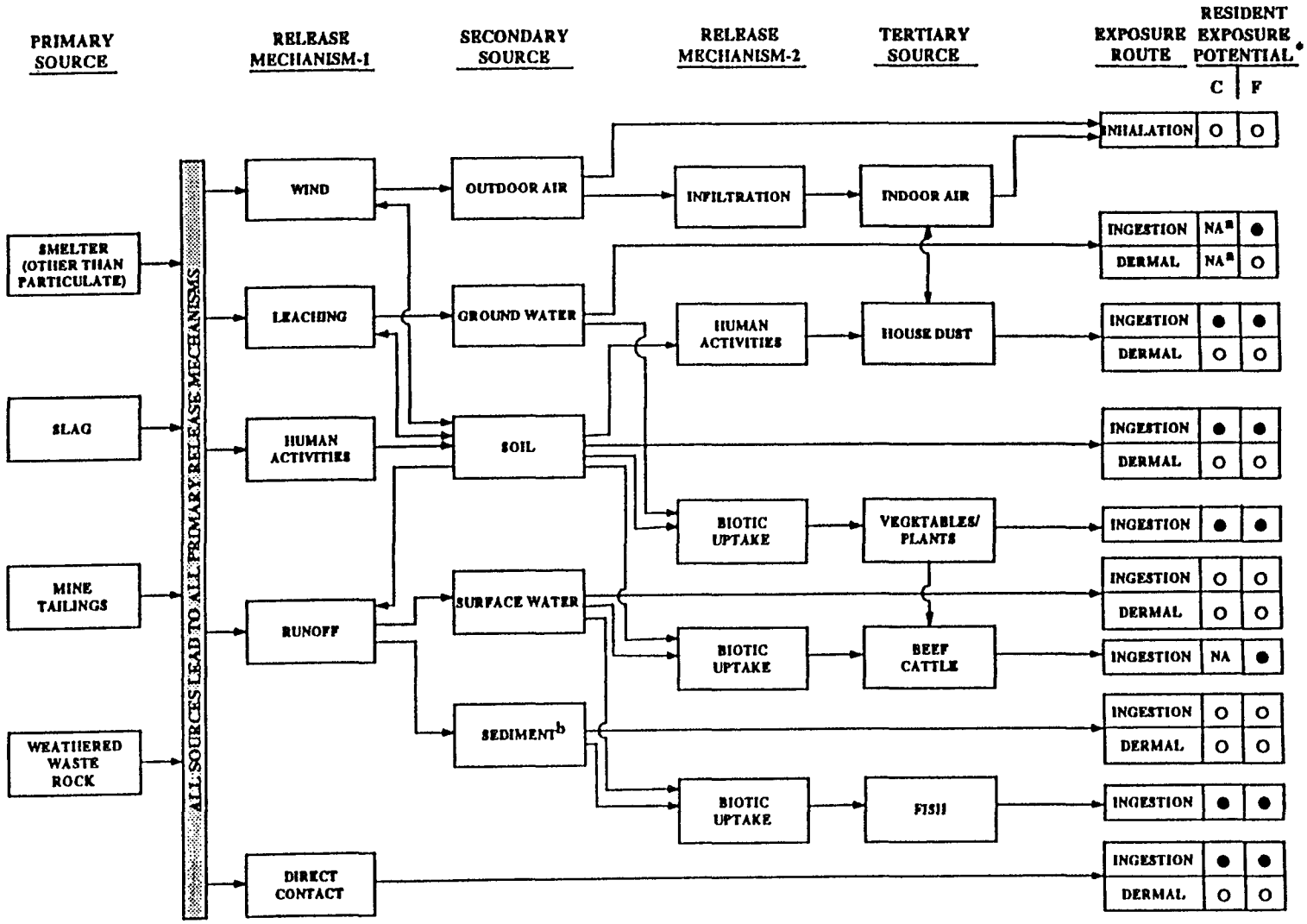
4.0 REMAINING CONCERNS

Remaining Concerns

Based on review of the oral comments received during the public meetings, there are no outstanding issues associated with implementation of the proposed remedial action.

APPENDIX B

CONCEPTUAL SITE MODELS



O EXPOSURE OR DOSE POTENTIAL RELATIVELY LOW

● EXPOSURE OR DOSE POTENTIAL RELATIVELY HIGH

NA NOT APPLICABLE SINCE EXPOSURE PATHWAY IS NOT COMPLETE

a CURRENTLY INVESTIGATIONS ARE UNDERWAY TO DETERMINE ANY PRESENT GROUNDWATER USAGE IN THE LEADVILLE AREA

b REFERS TO WET SEDIMENTS. DRY SEDIMENTS WOULD BE SIMILAR TO THE PATHWAYS SHOWN FOR SOIL.

♦

C=CURRENT USE

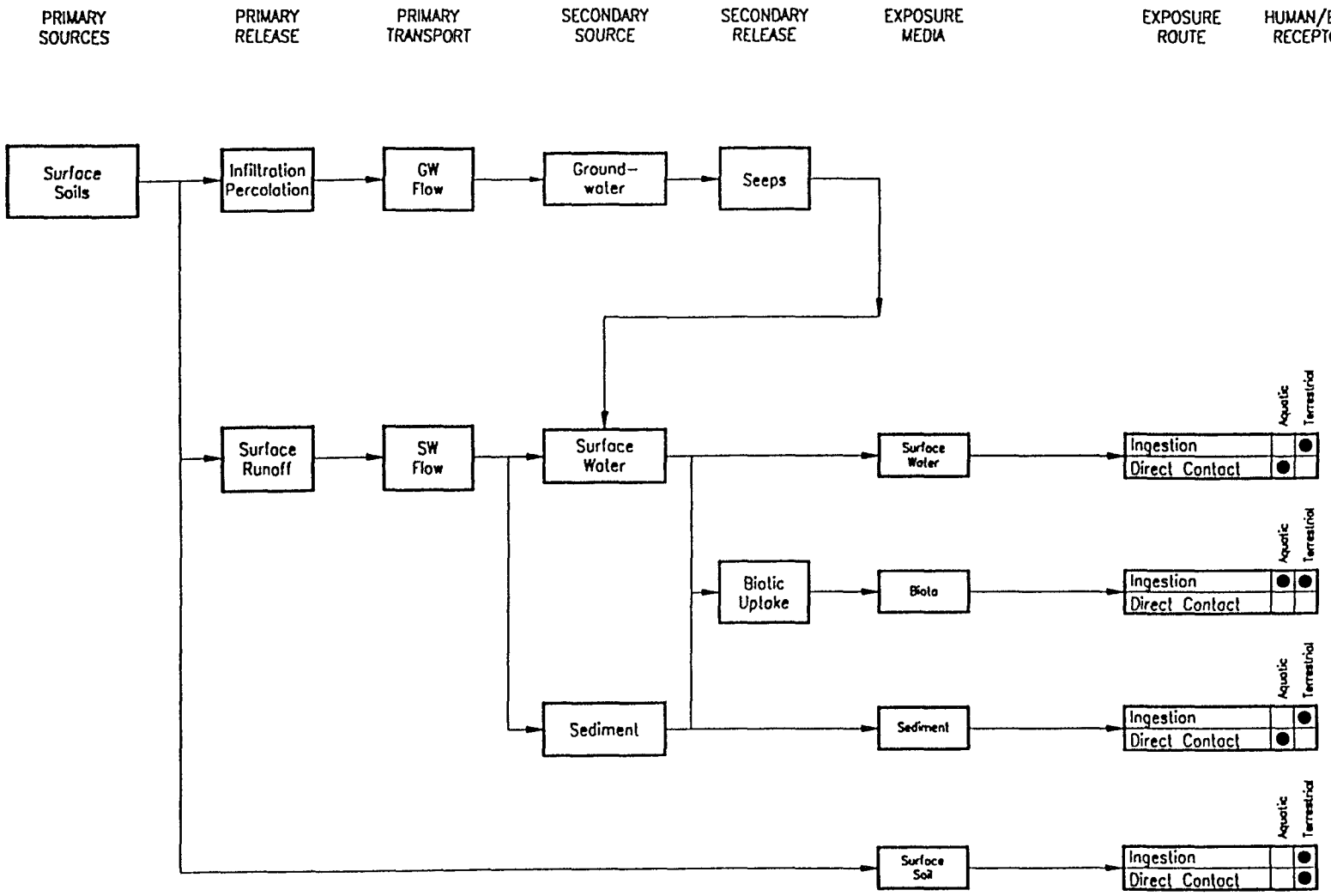
F=FUTURE USE

SOURCE: Preliminary Human Health Baseline Risk Assessment (WESTON, 1991)

Figure B-1

HUMAN HEALTH SITE CONCEPTUAL MODEL - LEADVILLE AND STRINGTOWN RESIDENTS, MINING AND ORE PROCESSING WASTES

California Gulch Superfund Site, Leadville, Colorado

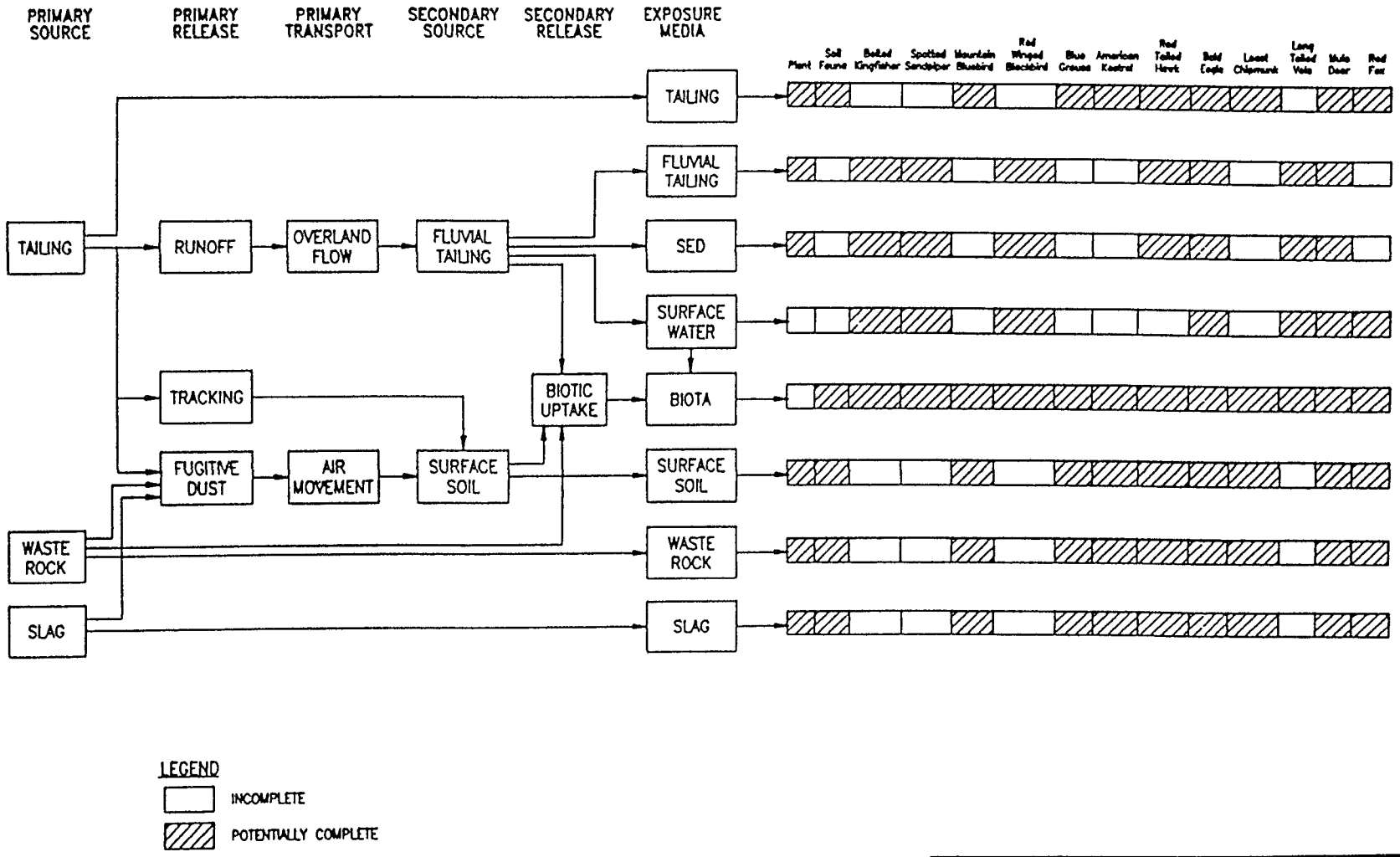


SOURCE: Final Baseline Aquatic Ecological Risk Assessment (WESTON, 1995b)

Figure B-2

CONCEPTUAL MODEL FOR CALIFORNIA GULCH ECOLOGICAL ASSESSMENT

California Gulch Superfund Site
Leadville, Colorado



SOURCE: Ecological Risk Assessment for Terrestrial Ecosystem (WESTON, 1997)

Figure B-3

CONCEPTUAL SITE MODEL
ECOLOGICAL RISK ASSESSMENT FOR THE TERRESTRIAL ECOSYSTEM

California Gulch Superfund Site, Leadville, Colorado